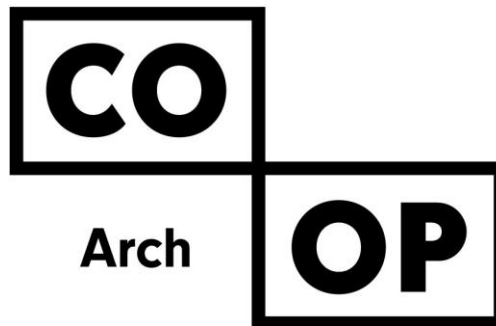


This project manual provides for liquidated damages in the amount of \$500 per calendar day for the contractor's delay in completion of the work. See Bid Form, Agreement for Construction, Article 10 of the General Conditions for details.

PROJECT MANUAL

School Addition Ellendale Public School District #40 Ellendale, ND

CO-OP PROJECT NO. 2446



LIQUIDATED DAMAGES

The anticipated construction schedule is as follows:

Commencement of Contract: **On or near April 14, 2025**

Commencement of Construction: **May 21, 2025**

Certificate of Substantial Completion: **July 17, 2026**

Final Completion: **July 31, 2026**

FOR EACH DAY PAST THE SUBSTANTIAL COMPLETION DATE, THE DELINQUENT PRIME CONTRACTOR SHALL PAY TO THE OWNER AS A PENALTY BY REASON OF FAILURE OF THE PRIME CONTRACT TO COMPLETE THE WORK REQUIRED OF HIM/HER WITHIN THE AGREED UPON PROGRESS SCHEDULE, A DAILY SUM BASED UPON THE FOLLOWING SCHEDULE:

(\$500 per calendar day) from July 17, 2026 thru SUBSTANTIAL COMPLETION.

THE PENALTY ASSESSED HEREUNDER NEITHER SHALL BE IN LIEU OF, NOR SHALL AFFECT ANY OTHER REMEDIES AVAILABLE TO THE OWNER AS A RESULT OF THE FAILURE TO COMPLETE THE WORK WITHIN THE AGREED UPON PROGRESS SCHEDULE. TIME IS OF THE ESSENCE IN CONSTRUING THE TERMS OF THE CONTRACT AND A MATERIAL CONSIDERATION THEREOF. THE PARTIES AGREE THAT DAMAGES IN THE EVENT OF CONTRACTORS BREACH WOULD BE DIFFICULT TO CALCULATE, AND THAT THE FOREGOING IS A FAIR AND REASONABLE ESTIMATE OF THE DAMAGES SUFFERED BY THE OWNER IN THE EVENT OF SUCH BREACH.

THE TIME FOR COMPLETION OF ALL ARCHITECT/ENGINEER/OWNER PUNCHLIST ITEMS SHALL NOT BE LATER THAN:

14 calendar days beyond SUBSTANTIAL COMPLETION.

FOR EACH DAY PAST THE ABOVE DATE, THE DELIQUENT PRIME CONTRACTOR SHALL PAY TO THE OWNER THE FOLLOWING SUM:

\$250 PER DAY

THE PENALTY ASSESSED HEREUNDER NEITHER SHALL BE IN LIEU OF, NOR SHALL AFFECT ANY OTHER REMEDIES AVAILABLE TO THE OWNER AS A RESULT OF THE FAILURE TO COMPLETE THE WORK WITHIN THE AGREED UPON PROGRESS SCHEDULE. TIME IS OF THE ESSENCE IN CONSTRUING THE TERMS OF THE CONTRACT AND A MATERIAL CONSIDERATION THEREOF. THE PARTIES AGREE THAT DAMAGES IN THE EVENT OF CONTRACTORS BREACH WOULD BE DIFFICULT TO CALCULATE, AND THAT THE FOREGOING IS AIR AND REASONABLE ESTIMATE OF THE DAMAGES SUFFERED BY THE OWNER IN THE EVENT OF SUCH BREACH.

SCHOOL ADDITION

ELLENDALE PUBLIC SCHOOL DISTRICT #40

ELLENDALE, ND

CO-OP 2446

March 12, 2025

Project Contacts:

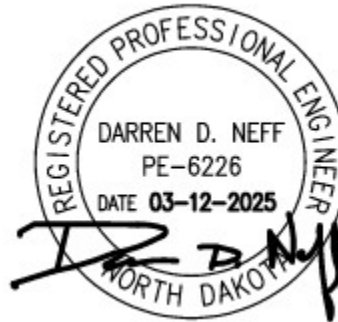
Architect: CO-OP Architecture
Mr. Spencer Sommers, AIA
1108 S Main St #102
Aberdeen, SD 57401
Ph: 605-725-4852



Civil Engineer: Helm & Associates
Mr. Brandon Smid, PE
416 Production Street North
Aberdeen, SD 57401
Ph: 605-225-1212



Structural Engineer: Heyer Engineering
Mr. Darren D. Neff, P.E..
436 East 8th Street
Sioux Falls, SD
Ph: 605-370-6139



Mechanical Engineer: Sichmeller Engineering
Mr. Martin Schmidt, P.E.
801 Railroad Ave. SE
Aberdeen, SD 57401
Ph: 605-225-4344



Electrical Engineer: Vareberg Engineering
Mr. Troy Vareberg, P.E.
1331 32nd Avenue South
Fargo, ND 58103-5989
Ph: 701-234-0926

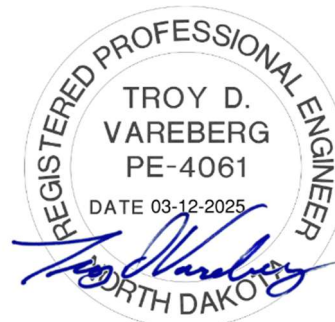


TABLE OF CONTENTS

Liquidated Damages
Title Sheet
Table of Contents
Index of Drawings

Bidding Information Requirements:

Notice to Bidders
Form of Proposal
Description of Alternates & Contract Clarifications

Instructions to Bidders & General Conditions:

Instructions to Bidders- AIA Document A701
General Conditions- AIA Document A201
Supplements to Instructions to Bidders
Supplements to Instructions to General Conditions

Soil Exploration

Phase II Environmental Site Assessment

DIVISION 01 - GENERAL REQUIREMENTS

011000	SUMMARY
012000	PRICE AND PAYMENT PROCEDURES
012200	UNIT PRICES
012300	ALTERNATES
012500	SUBSTITUTION PROCEDURES
012510	SUBSTITUTION REQUEST FORM
013000	ADMINISTRATIVE REQUIREMENTS
013216	CONSTRUCTION PROGRESS SCHEDULE
013223	SURVEY AND LAYOUT DATA
014000	QUALITY REQUIREMENTS
014523	QUALITY CONTROL – TESTING AND INSPECTING SERVICES
015000	TEMPORARY FACILITIES AND CONTROLS
016000	PRODUCT REQUIREMENTS
017000	EXECUTION AND CLOSEOUT REQUIREMENTS
017329	CUTTING AND PATCHING
017800	CLOSEOUT SUBMITTALS
017900	DEMONSTRATION AND TRAINING

DIVISION 02 – EXISTING CONDITIONS

020100	MAINTENANCE OF EXISTING CONDITIONS
024100	DEMOLITION

DIVISION 03 - CONCRETE

030516	UNDERSLAB VAPOR BARRIER
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031000 CONCRETE FORMING AND ACCESSORIES
032000 CONCRETE REINFORCING
033000 CAST-IN-PLACE CONCRETE
033511 CONCRETE FLOOR FINISHES

DIVISION 04 - MASONRY

042000 UNIT MASONRY

DIVISION 05 - METALS

051200 STRUCTURAL STEEL FRAMING
052100 STEEL JOIST FRAMING
053100 STEEL DECKING
055000 METAL FABRICATIONS
055213 PIPE AND TUBE RAILINGS

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

061000 ROUGH CARPENTRY
062000 FINISH CARPENTRY
064100 ARCHITECTURAL WOOD CASEWORK
068316 FIBERGLASS REINFORCED PANELING

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

072100 THERMAL INSULATION
072726 FLUID-APPLIED MEMBRANE AIR BARRIERS
074213 METAL WALL PANELS
075323 ETHYLENE-PROPYLENE-DIENE-MONOMER ROOFING (EPDM)
076200 SHEET METAL FLASHING AND TRIM
078400 FIRESTOPPING
079200 JOINT SEALANTS

DIVISION 08 - OPENINGS

081113 HOLLOW METAL DOORS AND FRAMES
081416 FLUSH WOOD DOORS
084313 ALUMINUM-FRAMED STOREFRONTS
087100 DOOR HARDWARE
088000 GLAZING
088300 MIRRORS

DIVISION 09 - FINISHES

092116 GYPSUM BOARD ASSEMBLIES
092216 NON-STRUCTURAL METAL FRAMING
093000 TILING

095100	ACOUSTICAL CEILINGS
096500	RESILIENT FLOORING
096566	RESILIENT ATHLETIC FLOORING
096813	TILE CARPETING
098430	SOUND-ABSORBING WALL AND CEILING UNITS
099000	PAINTING AND COATING

DIVISION 10 - SPECIALTIES

101100	VISUAL DISPLAY UNITS
101400	SIGNAGE
102113.19	PLASTIC TOILET COMPARTMENTS
102600	WALL AND DOOR PROTECTION
102800	TOILET, BATH, AND LAUNDRY ACCESSORIES
105113	METAL LOCKERS
105126	PLASTIC LOCKERS

DIVISION 11 - EQUIPMENT

116623	GYMNASIUM EQUIPMENT
--------	---------------------

DIVISION 12 - FURNISHINGS

122400	WINDOW SHADES
123600	COUNTERTOPS

DIVISION 21 - FIRE PROTECTION

211000	FIRE SUPPRESSION SYSTEMS
--------	--------------------------

DIVISION 22 - PLUMBING

220500	GENERAL PLUMBING REQUIREMENTS
220510	BASIC PLUMBING MATERIALS AND METHODS
220700	PLUMBING SYSTEMS INSULATION
224000	PLUMBING

DIVISION 23 - HEATING, VENTILATION AND AIR CONDITIONING

230500	GENERAL HVAC REQUIREMENTS
230510	BASIC HVAC MATERIALS AND METHODS
230593	TESTING, ADJUSTING, AND BALANCING
230700	HVAC SYSTEMS INSULATION
230900	CONTROLS AND CONTROL SEQUENCES
232113	HYDRONIC PIPING SYSTEMS
232123	HVAC HYDRONIC PUMPS
237000	VENTILATION AND AIR CONDITIONING

DIVISION 26 - ELECTRICAL

260500	COMMON WORK RESULTS FOR ELECTRICAL SYSTEMS
260510	MINOR ELECTRICAL DEMOLITION
260519	LOW VOLTAGE ELECTRICAL CONDUCTORS AND CABLES
260526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
260529	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
260533	RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS
260553	IDENTIFICATION FOR ELECTRICAL SYSTEMS
260923	LIGHTING CONTROL DEVICES
262416	PANELBOARDS
262726	WIRING DEVICES
262816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS
265119	LED LIGHTING

DIVISION 27 – COMMUNICATIONS

270500	COMMON WORK RESULTS FOR COMMUNICATIONS
271100	COMMUNICATIONS EQUIPMENT ROOM FITTINGS
271500	COMMUNICATIONS HORIZONTAL CABLING

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

280500	COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY
280513	CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY
283111	DIGITAL, ADDRESSABLE FIRE ALARM SYSTEM

DIVISION 03 – SITE CONCRETE

031100	CONCRETE FORMWORK
031500	CONCRETE JOINTS AND WATERSTOPS
032000	CONCRETE REINFORCEMENT
033000	CAST-IN-PLACE CONCRETE

DIVISION 31 – EARTHWORK

312300	EXCAVATION AND FILL
312311	WATERING FOR EMBANKMENTS
312314	SHEETING, SHORING, AND BRACING
312333	TRENCHING, BACKFILLING, AND COMPACTING
313419	GEOTEXTILE FABRICS

DIVISION 32 – EXTERIOR IMPROVEMENTS

321123	AGGREGATE MATERIAL
321216	ASPHALT CONCRETE SURFACING
321600	CURBS, GUTTERS, SIDEWALKS AND DRIVEWAYS

329219 SEEDING
329300 PLANTS

DIVISION 33 – UTILITIES

330 00 EXISTING UNDERGROUND UTILITIES
331100 WATER UTILITY PIPING AND FITTINGS
331216 WATER UTILITY DISTRIBUTION VALVES
333100 SANITARY SEWER PIPING AND FITTINGS

LIST OF DRAWING SHEETS

COVER

CODE

G000 CODE STANDARDS WALL TYPES AND SYMBOLS LEGEND
G001 GENERAL NOTES, CODE & ORIENTATION PLAN

CIVIL

C100 REMOVALS PLAN
C101 PARKING LOT PLAN AND PROFILE
C102 CONCRETE PAVEMENT AND STAIRS PLAN
C103 STAIR AND RAMP DETAILS
C104 BUS PARKING AREA IMPROVEMENTS
C105 DETAILS
C106 DETAILS

ARCHITECTURAL

A000 LANDSCAPE PLAN
A100.A DEMO AND PROPOSED PLAN - AREA A
A100.B DEMO AND PROPOSED PLAN - AREA B
A100.C DEMO AND PROPOSED PLAN - AREA C
A100.D DEMO AND PROPOSED PLAN - AREA D
A100.E DEMO AND PROPOSED PLAN - AREA E
A100.F DEMO AND PROPOSED PLAN - AREA F
A100.G DEMO AND PROPOSED PLAN - AREA G
A100.H DEMO AND PROPOSED PLAN - AREA H
A110.A FINISH & CEILING PLANS - AREA "A"
A110.B FINISH & CEILING PLANS - AREA "B"
A110.C FINISH & CEILING PLANS - AREA "C"
A110.D FINISH & CEILING PLANS - AREA "D"
A110.E FINISH & CEILING PLANS - AREA "E"
A110.F FINISH & CEILING PLANS - AREA "F"
A110.G FINISH & CEILING PLANS - AREA "G"
A110.H FINISH & CEILING PLANS - AREA "H"
A111 FINISH SCHEDULE & LEGENDS
A120 ROOF PLANS
A121 ROOF PLAN ADDITION
A300 BUILDING ELEVATIONS & SECTIONS
A301 BUILDING ELEVATIONS & SECTIONS
A310 WALL SECTIONS

A311	WALL SECTIONS
A400	INTERIOR ELEVATIONS
A401	ENLARGED PLANS & INTERIOR ELEVATIONS
A402	INTERIOR ELEVATIONS
A411	CEILING DETAILS
A412	INTERIOR DETAILS
A500	EXTERIOR SIGNAGE + DETAILS
A501	ROOF DETAILS
A600	DOOR & WINDOW SCHEDULE
A601	DOOR & WINDOW DETAILS
A602	DOOR & WINDOW DETAILS
A603	DOOR & WINDOW DETAILS

STRUCTURAL

S001	GENERAL NOTES
S002	GENERAL NOTES
S101.H	FOOTING & FOUNDATION PLAN AREA H
S201.H	ROOF FRAMING PLAN AREA H
S301	FOUNDATION DETAILS
S302	FOUNDATION DETAILS
S401	FRAMING DETAILS
S402	FRAMING DETAILS
S403	FRAMING DETAILS
S404	FRAMING DETAILS
S405	FRAMING DETAILS

MECHANICAL

EM100	MOTOR SCHEDULE, LEGEND & SHEET INDEX
M101	MECHANICAL SITE PLAN
M102	MECHANICAL ROOF PLAN
M200.A	DEMO & PROPOSED BELOW GRADE PLUMBING & HYDRONICS PLAN - AREA A
M200.B	DEMO & PROPOSED BELOW GRADE PLUMBING & HYDRONICS PLAN - AREA B
M200.C	DEMO & PROPOSED BELOW GRADE PLUMBING & HYDRONICS PLAN - AREA C
M200.D	DEMO & PROPOSED BELOW GRADE PLUMBING & HYDRONICS PLAN - AREA D
M200.E	DEMO & PROPOSED BELOW GRADE PLUMBING & HYDRONICS PLAN - AREA E
M200.F	DEMO & PROPOSED BELOW GRADE PLUMBING & HYDRONICS PLAN - AREA F
M200.G	DEMO & PROPOSED BELOW GRADE PLUMBING & HYDRONICS PLAN - AREA G
M200.H	DEMO & PROPOSED BELOW GRADE PLUMBING & HYDRONICS PLAN - AREA H
M300.A	DEMO & PROPOSED ABOVE GRADE PLUMBING & HYDRONICS PLAN - AREA A
M300.B	DEMO & PROPOSED ABOVE GRADE PLUMBING & HYDRONICS PLAN - AREA B
M300.C	DEMO & PROPOSED ABOVE GRADE PLUMBING & HYDRONICS PLAN - AREA C

M300.D DEMO & PROPOSED ABOVE GRADE PLUMBING & HYDRONICS PLAN - AREA D
M300.E DEMO & PROPOSED ABOVE GRADE PLUMBING & HYDRONICS PLAN - AREA E
M300.F DEMO & PROPOSED ABOVE GRADE PLUMBING & HYDRONICS PLAN - AREA F
M300.G DEMO & PROPOSED ABOVE GRADE PLUMBING & HYDRONICS PLAN - AREA G
M300.H DEMO & PROPOSED ABOVE GRADE PLUMBING & HYDRONICS PLAN - AREA H
M400 FIRE PROTECTION - LEGENDS & DETAILS
M400.A FIRE PROTECTION PLAN - AREA A
M400.B FIRE PROTECTION PLAN - AREA B
M400.C FIRE PROTECTION PLAN - AREA C
M400.D FIRE PROTECTION PLAN - AREA D
M400.E FIRE PROTECTION PLAN - AREA E
M400.F FIRE PROTECTION PLAN - AREA F
M400.G FIRE PROTECTION PLAN - AREA G
M400.H FIRE PROTECTION PLAN - AREA H
M500.A DEMO & PROPOSED HVAC PLAN - AREA A
M500.B DEMO & PROPOSED HVAC PLAN - AREA B
M500.C DEMO & PROPOSED HVAC PLAN - AREA C
M500.D DEMO & PROPOSED HVAC PLAN - AREA D
M500.E DEMO & PROPOSED HVAC PLAN - AREA E
M500.F DEMO & PROPOSED HVAC PLAN - AREA F
M500.G DEMO & PROPOSED HVAC PLAN - AREA G
M500.H DEMO & PROPOSED HVAC PLAN - AREA H
M501 HVAC TEMPERATURE CONTROL ZONE PLAN
M600 PLUMBING FIXTURE SCHEDULE
M700 MECHANICAL DETAILS
M701 MECHANICAL DETAILS CONTINTUED
M702 MECHANICAL SECTIONS
M703 MECHANICAL SCHEDULES

ELECTRICAL

E000 SITE PLAN - ELECTRICAL / SYMBOLS / ABBREVIATIONS
E001 MAIN LEVEL OVERALL PLAN - ELECTRICAL DEMOLITION
E101 MAIN LEVEL - AREA "H" - LIGHTING
E200 MAIN LEVEL OVERALL PLAN - POWER
E201 MAIN LEVEL PLAN - AREA "H" - POWER
E202 ROOF PLAN - AREA "H" - POWER
E300A MAIN LEVEL OVERALL PLAN CLOCK/SPEAKER SYSTEM
E300B MAIN LEVEL OVERALL PLAN - FIRE ALARM
E301 MAIN LEVEL PLAN - AREA "H" - SYSTEMS
E400 SCHEDULES & DETAILS

NOTICE TO BIDDERS

Sealed bids will be received by the Ellendale Public School of Ellendale, North Dakota for the proposed construction related to the **Ellendale School Addition** until **2:00 p.m., local time on Friday the 11th of April, 2025**. The bid letting will be held at the 321 N 1st St, Ellendale, ND 58436 in the library near the main building entrance (door #1) to the south. A pre-bid meeting will be held on site at 10:30 a.m., local time on Friday the 21 of March, 2025.

Copies of the Plans and Specifications will be made available electronically (pdf format). Technical questions shall be directed to Brian Skrovig, Sioux Falls, South Dakota at 605-334-9999, or brian@co-oparch.com.

Bidding documents may also be examined at the following locations:

Sioux Falls Builders Exchange, Sioux Falls, SD
Plains Builders Exchange, Sioux Falls, SD
Aberdeen Builders Exchange, Aberdeen, SD
Fargo-Moorhead Builders Exchange, Fargo, ND
Minot Building Exchange, Minot, ND
Bismarck-Mandan Builders Exchange, Bismarck, ND
Minnesota Builders Exchange, Minneapolis, MN

Bids shall be submitted to the Ellendale Public School in a sealed envelope with the name and address of the bidder clearly identified on the envelope and the words "Bid for Ellendale School Addition". All bidders shall take note of the AIA Document A701 "Instructions to Bidders", and the AIA Document A201 "General Conditions of the Contract for Construction". Faxed bids will not be accepted; nor, will faxed bid adjustments be accepted.

No bidder may withdraw a bid for 30 days following the bid opening without a written request explaining the cause of the withdrawal and without written consent of the Owner after reviewing the cause.

Liquidated damages shall be in effect for this project. See Bid Form, Agreement for Construction, and the General Conditions for details.

Each bid shall be accompanied by a certified check, a cashier's check or draft certified or issued by a state or national bank, in the amount of at least five percent (5%) of the total amount of the bid, payable to Ellendale Public School; or in lieu thereof, bidder may furnish a bid bond in the amount of not less than ten percent (10%) of the amount of the bid, such bond to be issued by a surety authorized to do business in the State of North Dakota and payable to Ellendale Public School as a guarantee that such bidder will enter into a contract for the work described in the bid and as specified.

The Ellendale Public School reserves the right to reject any part of, or all bids, and to waive any informalities or irregularities therein.

By virtue of statutory authority preference will be given to contracts, labor, materials, products, and supplies found or produced with the State of North Dakota in a manner provided by law.

Ellendale Public School District #40
of Ellendale, North Dakota

By: Lana Norton
Business Manager

Please Publish: March 13th, 2025
March 20th, 2025
March 27th, 2025

BID FORM

PROJECT: School Addition
Ellendale Public School

TO: Ellendale Public School District #40
321 North 1st Street
Ellendale, North Dakota 58436

Bid of: _____
(hereinafter called "Bidder")

The Bidder, in compliance with your Advertisement for Bids for the Complete Construction (general, mechanical and electrical) work for the proposed building renovations, having examined the drawings and specifications with related documents and the site of the proposed work, and being familiar with all of the conditions surrounding the construction of the proposed project, including the availability of materials and labor, hereby proposes to furnish all labor, materials and supplies, and to construct the project in accordance with the Contract Documents, within the time set forth therein, and at the prices stated below. These prices are to cover all expenses incurred in performing the work required under the Contract Documents of which this Bid is a part. Bidder hereby agrees to commence work under this Contract on or before a date to be specified in written "Notice to Proceed" of the Owner, and to fully complete the project at the dates set forth in the Contract Documents.

BIDDER AGREES TO PERFORM THE COMPLETE CONSTRUCTION for the following sum:

For the following Base Bid:
_____ (\$ _____)

For the following Alternate #1 (NE Parking Lot Area):
_____ (\$ _____)

For the following Alternate #2 (SW Site Improvements):
_____ (\$ _____)

For the following Alternate #3 (North Area Landscape Improvements):
_____ (\$ _____)

For the following Alternate #4 (Existing North Façade Improvements):
_____ (\$ _____)

For the following Alternate #5 (Fire Alarm Device & Wiring Upgrade):
_____ (\$ _____)

For the following Alternate #6 (Wrestling Room Wall Mats):
_____ (\$ _____)

For the following Alternate #7 (Wrestling Floor Mat):

_____ (\$ _____)

For the following Alternate #8 (LVT Flooring Instead of Rubber Track Flooring):

_____ (\$ _____)

For the following Alternate #9 (Data Cabling):

_____ (\$ _____)

UNIT PRICES:

Item 1 – Imported and Compacted Fill \$ _____ Per CuYd

Item 2 – Over Excavation of Unsuitable Material \$ _____ Per CuYd

ADDENDA:

The undersigned acknowledge receipt of addenda as noted and the bid submitted herewith is in accordance with the stipulations set forth herein.

ADDENDUM NO _____ DATED _____

ADDENDUM NO _____ DATED _____

ADDENDUM NO _____ DATED _____

The undersigned agrees that his bid may not be withdrawn for a period of 30 days from the time set for opening of bids and that if notified of acceptance of his Proposal within the stated time, or at any time thereafter before the bid is withdrawn, he will within ten (10) days of such notification, execute and deliver a Contract in the Form of Contract specified.

The Contractor shall commence work under this Contract within ten (10) calendar days after the date of receipt by him of Notice to Proceed, to prosecute said work diligently, and to complete the entire project ready for use at the dates set forth in the Contract Documents. The time stated for completion shall include a time allowance for inspections, completion of items requiring further attention and a final cleanup of premises.

The above bid includes State and Local Sales Tax on materials and all other State and Federal Taxes that would affect the amount of the bid.

In submitting this bid it is understood that the right is reserved by the Architect and Owners to reject any and all bids and to waive all informalities.

BIDDER: _____

BY: _____

TITLE: _____

BUSINESS
ADDRESS: _____

STATE OF
INCORPORATION: _____
(SEAL)

DESCRIPTION OF ALTERNATES & CONTRACT CLARIFICATIONS

ALTERNATE #1 – NE Parking Lot Area (Add Alternate)

As shown and indicated on the contract drawings, all necessary work to construct the new asphalt parking lot area, including but not limited to excavation and grading, concrete curb & gutter, concrete and asphalt pavement, plantings, pavement markings, lighting, and wiring. See contract drawings for details.

ALTERNATE #2 – SW Site Improvements (Add Alternate)

As shown and indicated on the contract drawings, all necessary work to construct the new grass area in the SW corner of the site. Including but not limited to excavation and grading, topsoiling and planting, electrical outlet improvements, and domestic water stub out to be irrigation ready. See contract drawings for details.

ALTERNATE #3 – North Area Landscape Improvements (Add Alternate)

As shown and indicated on the contract documents, all necessary work to construct landscape areas west of the north entrance and between building area A and H, including but not limited to planted grass areas, cast-in-place concrete planter boxes, and planter plantings. See contract drawings for details.

ALTERNATE #4 – Existing North Façade Improvements (Add Alternate)

As shown and indicated on the contract drawings, all necessary work to improve existing EIFS building façade along the exterior of the building. Including but not limited to new metal panel, flashings, coping, and signage. See contract drawings for details.

ALTERNATE #5 – Fire Suppression Upgrade (Add Alternate)

As shown and indicated on the contract drawings, all necessary work to provide fire suppression throughout existing school, including but not limited to existing ceiling modifications, fire suppression materials and installation costs. Fire suppression in new addition only, to be a part of the base bid. See contract drawings for details.

ALTERNATE #6 – Wrestling Room Wall Mats (Add Alternate)

As shown and indicated on the contract drawings, all work necessary to provide wrestling wall mats in the wrestling room, including but not limited to materials, wall prep, site coordination, and install. See contract drawings for details.

ALTERNATE #7 – Wrestling Floor Mat (Add Alternate)

As shown and indicated on the contract drawings, all work necessary to provide a new wrestling floor mat in the wrestling room, including but not limited to materials, floor prep, site coordination, and install. See contract drawings for details.

ALTERNATE #8 – LVT Flooring Instead of Rubber Track Flooring (Add Alternate)

As shown and indicated on the contract drawings, provide alternate flooring finish at the rubber walking track, including but not limited to, materials, floor prep, site coordination, and install. See contract drawings for details.

ALTERNATE #9 – Data Cabling (Add Alternate)

Material and labor to be included in as an alternate, including but not limited to jacks, wiring, data racks, patch panels, and testing to be included in project by the EC. Any switches, routers, wireless access points, and fiberoptic patch panels are not in project scope and are to be owner provided if alternate is accepted.

CONSTRUCTION DOCUMENT CONTRACT CLARIFICATIONS

- Adjustments to heating & chilled water hydronic system solutions (any additional inhibitor and or glycol), these systems will be tested after contracts are awarded and anything additional required after identified by testing would be additional to the contract.
- Security scope – EC to do rough in and provide cabling, owner to provide and install the camera.
 - To follow up with plan mark-up
- Audio upgrades to existing building system – material and labor to be included in project scope. Will include all rough ins, pathways, data cabling, termination, and testing for all audio enhancement systems and door access systems (All inclusive, no work/equipment by Owner)
 - Hook up phone to play over speakers in gym, aux gym, wellness, and wrestling.
- Door Access System material and labor to be included in project bid by *DRN*. *DRN* is used as provider for wiring and equipment to be included in the project by the EC. (All inclusive, no work/equipment by Owner)
- Data cabling scope is not in base bid, see alternate #9. Material and labor to be included in as an alternate, including but not limited to jacks, wiring, data racks, patch panels, and testing to be included in project by the EC. Any switches, routers, wireless access points, and fiberoptic patch panels are not in project scope and are to be owner provided if alternate is accepted.
- Casework and Equipment
 - Wellness room equipment to be owner provided and installed. See contract drawings for details.
 - Lockers are in base bid of project scope. See contract drawings for details.
 - Soap and paper towel dispensers to be owner provided. See contract drawings for details.
- Wellness room mirrors
 - To be priced in base bid of project scope. See contract drawings for details.
- Wellness room TV's
 - TV mount and TV to be provided and installed by owner. See contract drawings for detail.

AIA[®] Document A701[®] – 2018

Instructions to Bidders

for the following Project:
(Name, location, and detailed description)

Ellendale School Addition
321 North 1st Avenue
Ellendale, ND 58436

THE OWNER:

(Name, legal status, address, and other information)

Ellendale Public School District #40
321 North 1st Avenue
Ellendale, ND 58436
(701) 349-3232

THE ARCHITECT:

(Name, legal status, address, and other information)

Collaborative Operandi Architecture, LLC
D.B.A. CO-OP Architecture
1108 South Main Street, Suite 102
Aberdeen, South Dakota 57401
(605) 725-4852

TABLE OF ARTICLES

- 1 DEFINITIONS
- 2 BIDDER'S REPRESENTATIONS
- 3 BIDDING DOCUMENTS
- 4 BIDDING PROCEDURES
- 5 CONSIDERATION OF BIDS
- 6 POST-BID INFORMATION
- 7 PERFORMANCE BOND AND PAYMENT BOND
- 8 ENUMERATION OF THE PROPOSED CONTRACT DOCUMENTS

ADDITIONS AND DELETIONS:

The author of this document may have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes revisions to the standard form text is available from the author and should be reviewed. A vertical line in the left margin of this document indicates where the author has added to or deleted from the original AIA text.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

FEDERAL, STATE, AND LOCAL LAWS MAY IMPOSE REQUIREMENTS ON PUBLIC PROCUREMENT CONTRACTS. CONSULT LOCAL AUTHORITIES OR AN ATTORNEY TO VERIFY REQUIREMENTS APPLICABLE TO THIS PROCUREMENT BEFORE COMPLETING THIS FORM.

It is intended that AIA Document G612™–2017, Owner's Instructions to the Architect, Parts A and B will be completed prior to using this document.

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Supplements to Instructions to Bidders

AIA Document A-701 "Instructions to Bidders" latest Edition shall pertain to this contract. The following information and supplements shall modify, change, delete or add to this document. Where any part of the Instructions to Bidders is modified or voided by the following articles, the unaltered provisions of that part shall remain in effect.

3.1.1 Copies of the Plans and Specifications will be made available electronically (pdf format). Technical questions shall be directed to CO-OP Architecture, LLC, Sioux Falls, South Dakota at 605-334-9999 or brian@co-oparch.com.

4.1.1.1 Bids will be received for one prime contract:

4.2.1 Bid Security will be required on this project as specified in Advertisement for Bids.

4.3.1. Bids shall be submitted in sealed envelope plainly marked on face as follows:

Bidders Name

Bidders Address

Proposal For: General Construction

Project: Ellendale School Addition

Location: Ellendale, North Dakota

4.3.2. Bids will be received as follows:

Date: **April 11, 2025**

Time: **2:00 p.m.**

Location:

Ellendale School District

321 North 1st Street

Ellendale, North Dakota 58436

4.4.1. Bids may not be modified, withdrawn or cancelled for thirty (30) days following date for receipt of bids.

5.1. Bids will be publicly opened and read aloud.

6.1. Contractors Qualification Statement, AIA Document A305 will not be required prior to bidding but may be required prior to award of contract. If same is requested, it shall be submitted within ten days from date of request.

- 6.3.1. Forms for submittals of items 6.3.1.1., 6.3.1.2. and 6.3.1.3 will be supplied by the architect. Forms to be submitted in two copies.

- 7.1.1. Performance Bond and Payment Bond will be required of successful prime contractor and cost of same to be included in the bid. Bond shall be executed on AIA Standard Form A312, with amount shown on each part equal to 100 percent of the total amount payable by terms of the contract. Surety shall be company licensed to do business in North Dakota and acceptable to architect and owner. Two copies of each are required. Bonds to be issued to owner, same as Bid Security listed in Advertisement for Bids.

- 8.1. A copy of this agreement may be examined by bidders at the office of the architect.

General Conditions of the Contract for Construction

for the following PROJECT:

(Name and location or address)

Ellendale School Addition
321 North 1st Avenue
Ellendale, ND 58436

THE OWNER:

(Name, legal status and address)

Ellendale Public School District
321 North 1st Avenue
Ellendale, ND 58436

THE ARCHITECT:

(Name, legal status and address)

Collaborative Operandi Architecture, LLC
D.B.A. CO-OP Architecture
1108 South Main Street, Suite 102
Aberdeen, South Dakota 57401

TABLE OF ARTICLES

- 1 GENERAL PROVISIONS
- 2 OWNER
- 3 CONTRACTOR
- 4 ARCHITECT
- 5 SUBCONTRACTORS
- 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS
- 7 CHANGES IN THE WORK
- 8 TIME
- 9 PAYMENTS AND COMPLETION
- 10 PROTECTION OF PERSONS AND PROPERTY
- 11 INSURANCE AND BONDS
- 12 UNCOVERING AND CORRECTION OF WORK

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This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™–2017, Guide for Supplementary Conditions.

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SUPPLEMENTS TO GENERAL CONDITIONS

AIA Document A-207-2017 "General Conditions of the Contract for Construction", shall pertain to this contract. The following information and supplements shall modify, change, delete or add to this document. Where any part of the General Conditions is modified or voided by the following articles, the unaltered provisions of that part shall remain in effect.

Article 3 – Contractor:

Add the following:

3.10.4. Progress Schedule shall be submitted by general contractor in six copies within ten days after date of Notice to Proceed. Architect will distribute to each other prime contractor and owner.

3.15.3 All glass shall be fully protected from damage of any kind. Do not allow mortar or any other substance to remain on glass. Just prior to final inspection, the general contractor shall replace any broken glass; clean all glass; remove stains, spots, marks or other dirt from his work; clean all walks and drives by washing and/or sweeping; remove all construction equipment and excess materials from site; clean hardware; remove all paint spots; clean all walls if necessary and clean all floors in accordance with the instructions of flooring sub-contractor.

Article 7 – Changes in the Work

Add the following:

7.2.1.4. Change orders will be prepared in three copies. Likewise, change order proposals shall be prepared in three copies and shall contain a complete breakdown of all costs and substantiating proposals from subcontractors if involved, shall be attached, Subcontractor proposals also to contain a complete breakdown.

7.2.1.5. Maximum allowance for overhead and profit on add or deduct change orders shall be 5% for overhead and 5% for profit. The cost of the Bond, Builders Risk, basic construction plant, home office, general superintendent and the like, shall be considered part of the overhead cost. Add or deduct control orders will be computed on the same basis. For change orders of work where the prime contractor (Architectural Trades, Mechanical or electrical) has awarded the work to a subcontractor, the prime contractor shall be allowed one fee only in an amount not to exceed 10% on add or deduct change orders.

Article 9 – Progress Payments:

9.6.1. Add the following:

Progress payment retainage: The contract shall be so conditioned that it will provide for retention of not less than the following percentages:

10% of the amount of the contract until the contract shall be fully executed and completed to the satisfaction and acceptance of the owner.

9.10.2. The requirements of this paragraph must be met prior to issuance of final certificate for payment. The contractor will submit AIA Documents G706, G706A, and G707 to architect to meet compliance.

Article 10 – Protection of Persons and Property:

Add the following:

10.2.7. All parts of the work shall be braced to resist wind or other loads. The contractor shall perform the work with the explicit understanding that the design of the project is based on all parts of the work having been completed and as such, the methods of performance of each part of the work shall be done accordingly.

10.2.8. Temporary items such as, but not limited to:

Scaffolding, staging, lifting, and hoisting devices, shoring, excavation, barricades, and safety and construction procedures necessary in completion of the project shall be the responsibility of the contractors and their subcontractors and shall comply with the applicable codes and regulations. OSHA Standards for the Construction Industry (29CFR Part 1926) shall be complied with in every respect. It shall not be the responsibility of the owner or the architect to determine if the contractors, subcontractors, their representatives are in compliance with the aforementioned regulations.

Article 11 – Insurance and Bonds

11.1 Contractor's Insurance and Bonds

Add the following clauses to 11.1.1:

11.1.1.1 The Insurer shall have an A.M. Best rating of "A" or better.

11.1.1.2 Liability Insurance shall include all major division of coverage and be on comprehensive basis including:

1. Premises Operations (including X, C and U coverages as applicable).
2. Independent Contractor's Protective.
3. Personal Injury Liability with Employment Exclusion deleted.
4. Contractual, including specified provision for Contractor's obligation under Paragraph 3.18.
5. Broad Form Property Damage including Completed Operations.

11.1.1.3 If the General Liability coverages are provided by a Commercial General Liability Policy on a claims-made basis, the policy date or Retroactive Date shall predate the Contract; the termination date of the policy or applicable extended reporting period shall be no earlier than the termination date of coverages required to be maintained after final payment, certified in accordance with Subparagraph 9.10.2.

11.1.1.4 The insurance required by Subparagraph 11.1.1 shall be written for not less than the following limits, or greater if required by law:

1. Workers Compensation:
 - a. State: South Dakota Statutory
 - b. Applicable Federal (e.g. Longshoremen's): Statutory
 - c. Employer's Liability:

\$100,000 per Accident
\$500,000 Disease, Policy Limit
\$100,000 Disease, Each Employee
2. Commercial General Liability (including Premises-Operations; Independent Contractor's Protective; Products and Completed Operations; Broad Form Property Damage Contractual, Personal Injury:
 - a. \$1,000,000 Each Occurrence
 - b. Owner shall be included as an Additional Insured on the Contractor's General Liability coverage on a Primary Non Contribution basis including completed operations.
 - c. General Aggregate; \$2,000,000

- d. Products and Completed Operations to be maintained for two years after final payment.
 - e. Property Damage Liability Insurance shall provide X,C, and U coverage. Any exception to the above must be noted on Certificate.
 - f. Broad Form Property Damage Coverage shall include Completed Operations.
 - g. Personal Injury and Advertising, with Employment Exclusion deleted:

\$1,000,000.
 - h. If the General Liability coverages are provided by a Commercial Liability policy, the:

General and Products and Completed Operations aggregate shall not to be less than \$1,000,000 and it shall apply, in total, to this project only. If, under terms of a Commercial General Liability or for products and completed operations aggregate policy or Commercial Umbrella Liability policy or the general aggregate amount specified for this project only, is reduced up to 10% by the total of all claims, paid and pending, for which the Contractor is or may be liable, the Contractor shall notify the Owner within 10 days of such reduction or potential reduction. Contract shall indicate in the notification separate totals for each category, paid and pending. If instructed by the Owner in writing, the Contractor shall, at its own expense, restore the general aggregate to their original amounts. Contractor shall, within 30 days receipt of such notice, submit a revised Certificate of Insurance indicating restoration of required general aggregates. The Contractor may, on its own, restore the general aggregate to the original amounts for this project only at any time during the progress of the work without relying on notification by Owner.
 - i. Fire Damage Limit shall be not less than \$50,000 on any one fire.
 - j. Medical Expense Limit shall be not less than \$5,000 on any one person.
3. Business Auto Liability (including owned, non-owned and hired vehicles):
- a. Bodily Injury:

\$500,000 Each Person OR for 3a), b) \$1,000,000 CSL

\$1,000,000 Each Occurrence

b. Property Damage:

\$500,000 Each Occurrence

4. Umbrella Excess Liability:

\$1,000,000 Each Occurrence

\$1,000,000 General Aggregate

\$1,000,000 Products & Completed Operations Aggregate

\$1,000,000 Retention for self-insured hazards each occurrence.

Soil Technologies, Inc.

28822 124th Street – Mobridge, SD 57601 – (605) 762-3406

www.soil-technologies.com

“Building Your Success On A Solid Foundation”

December 9, 2024

Ellendale Public School District

Attn: Mr. Chip Sundberg
c/o Co-op Architecture
1108 S. Main St.
Aberdeen, South Dakota 57401

Subj: Soil Exploration
Proposed School Building Addition
Ellendale Public School
Ellendale, ND
STI #24-1896

This report presents the findings of the Soil Exploration for the above referenced project. The exploration was performed in accordance with your authorization of our proposal to you dated November 30, 2024. An electronic file copy is being sent to you.

Soil Technologies, Inc. (STI) is dedicated to providing our clients with the most complete Soil Exploration and Geotechnical Engineering services. To accomplish this, a Geotechnical Engineer from Soil Technologies, Inc. should be retained to monitor the earthwork operations during construction. The Geotechnical Engineer will observe the soil conditions at the project site and judge when the excavations are satisfactorily completed. The Geotechnical Engineer's observations will help affirm that the earthwork is performed according to the recommendations of this report.

Thank you for the opportunity to perform these services for you on this project. If you have any questions regarding the contents of this report, or if we can be of further service to you, please feel free to contact us.

SOIL TECHNOLOGIES, INC.



**ELLENDALE PUBLIC
SCHOOL DISTRICT
ELLEDALE, ND**

**SOIL EXPLORATION
PROPOSED SCHOOL BUILDING
ADDITION
ELLENDALE PUBLIC SCHOOL
ELLENDALE, SD
STI #24-1896**

December 9, 2024

TABLE OF CONTENTS

STI #24-1896

1.0 INTRODUCTION	1
1.1 Project Information	1
2.0 ENGINEERING REVIEW	1
2.1 Discussion	2
2.2 Site Preparations	3
2.3 Foundations.....	9
2.4 Exterior Backfill.....	11
2.5 Site Drainage.....	12
2.6 Pavement Recommendations.....	13
3.0 CONSTRUCTION AND DESIGN CONSIDERATIONS	18
3.1 Construction Considerations.....	18
3.2 Design Considerations	19
4.0 EXCAVATION OBERVATION AND TESTING	21
5.0 GENERAL EXPLORATION INFORMATION	21
5.1 Scope of Exploration	21
5.2 Site Surface Conditions	22
5.3 Site Subsurface Conditions	22
5.4 Water Levels	22
5.5 Laboratory Test Program.....	23
6.0 LIMITATIONS, REVIEW, USE, AND PURPOSE OF REPORT	23
7.0 STANDARD OF CARE.....	24
Attachments:	
Boring Location Drawing (2)	
Borings Logs	
Field Exploration Procedures & “Descriptions”	
Symbols and Terminology	
Precautions...During Cold Weather	
Construction Observation and Testing	
Important Information about Your Geotechnical Report	

SOIL EXPLORATION
PROPOSED SCHOOL BUILDING ADDITION
ELLENDALE PUBLIC SCHOOL
ELLENDALE, ND
STI #24-1896

1.0 INTRODUCTION

1.1 Project Information

We understand the proposed project will consist of the construction of a school building addition located at the Ellendale Public School in Ellendale, ND. The proposed building will consist of a single-story, slab-on-grade, heated structure (no below grade floors or crawl space). It will house approximately 10,000 ft². The structure will be supported on shallow spread footing foundations. A driveway/parking lot will also be part of the project.

• **Conditions:**

- The finished floor elevation of the proposed building addition will match that of the adjacent east building and be at an elevation of 100.0 feet.*
- The perimeter frost footings of the proposed building will rest 4.5 to 6 feet below the finished floor and be at an elevation between 94.0 to 95.5 feet.*
- The new perimeter finished grades immediately surrounding the proposed building will be below the finished floor elevation.
- Column loads will be a maximum of 150 kips (total dead and live loads) with continuous footing loads less than 4 kips/ft (total dead and live loads).
- Uniform floor slab loadings exerted on the underlying soils will be a maximum 500 pounds per square foot (psf).

**Elevations based on the survey benchmark shown on the attached sketch.*

2.0 ENGINEERING REVIEW

The engineering recommendations provided in this report are based on the soil information obtained under this Soil Exploration along with the information and conditions of the project as described above. The recommendations are valid for the specific information and conditions listed. If there are additions, corrections, or changes to the above information or conditions, it is necessary that we be notified so that we can determine whether the new information or conditions affect our recommendations.

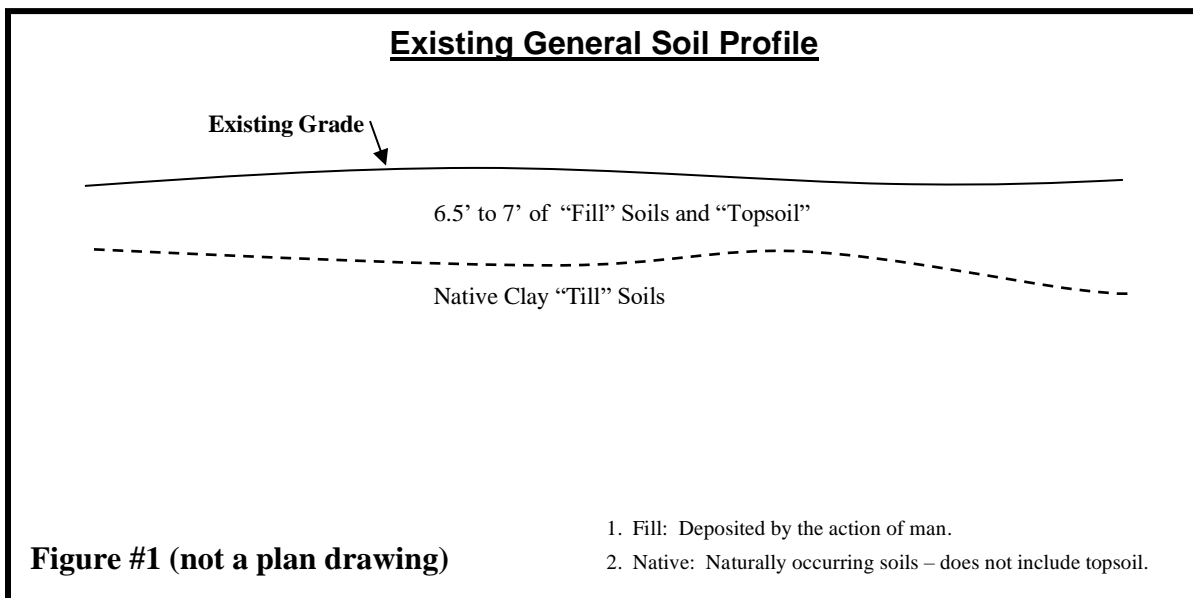
Our design assumptions include a minimum theoretical safety factor of 3 with respect to shearing or base failure of the foundations. We assume an allowable total settlement of 1 inch and a differential settlement of up to 1/2 inch over a length of 30 feet.

The recommendations in this report assume the location of the proposed building is within 50 feet of the boring locations as shown on the attached sketch. If the location of the proposed building is changed so as not to be within this distance for each of the respective borings, the opinions and recommendation of this report may not be applicable, and we must be contacted for additional review and potentially additional borings.

2.1 Discussion

• **Soil Profile**

The boring logs suggest that the general soil profile in the area of the proposed building addition (borings #1 - #4) consists of about 6.5 to 7 feet of sand and clay “fill” soils and clay “topsoil” overlying native clay “till” (glacial deposited soils) which extends to the termination depths of the borings at 16 feet below the existing grades. Please refer to Figure #1 below and the attached boring logs. Note: Hydrocarbon (fuel) odor was detected by smell on soil samples from about 4 to 16 feet. We recommend that you contact the ND Department of Environmental Quality to determine if remedial work is required.



Note: The existing “fill” soils are assumed to be “undocumented” and thus, they are considered uncontrolled fill that was not monitored nor tested for quality and compaction during placement.

- **General**

Based on the subsurface conditions encountered at the boring locations, it is our opinion that the native soils at the site will support the proposed structure on shallow spread footing foundations, provided the recommendations in this report are performed and the estimated settlements are acceptable. Listed below are some of the more prominent site conditions.

- **FOOTING AREAS:** Based on the boring logs, “fill” soils and “topsoil” exist at the building site (borings #1- #4) and extend from the surface to depths of about 6.5 to 7 feet below the existing grades. In our opinion, these soils are not suitable for support of the footings and should be removed from the footing areas. However, the native clay “till” soils below the “fill” soils and “topsoil” can be used for support of the footings.
- **FLOOR AREA:** As mentioned above, “fill” soils and “topsoil” were encountered at the building site and extend from the surface to depths of about 6.5 to 7 feet below the existing grades. Similar to the footing areas, it is our opinion that the “fill” soils and “topsoil” are not suitable for support of the floor and should be removed from the floor areas. However, the native clay “till” soils below the “fill” soils and “topsoil” can be used for support of the floor slab.

2.2 Site Preparations

FOOTINGS (Interior, Exterior, & Thickened Edged): In our opinion, the existing “fill” soils and “topsoil” should not be used for support of the footings. Thus, we recommend that site preparations in the footing areas consist of the excavation of the existing “fill” soils and “topsoil” to expose the underlying competent native clay “till” soils. The native clay “till” soils were encountered at depths of about 6.5 to 7 feet below the existing grades at the boring locations (#1- #4) of the proposed building.

The approximate minimum recommended footing area excavation depths and corresponding elevations at each boring location are shown in Table 1 below. They are also noted on each of the attached boring logs. Also, refer to Figure #2 on page 5 showing “Typical Building Site Preparations.” Keep in mind that the required footing excavation depths listed in Table 1 may be significantly different at other locations at the site, and the on-site Geotechnical Engineer may require the footing excavation depths to be significantly different at those other locations.

During the footing area excavations, the exposed native soils (clay “till”) at the bottom of the excavations should be observed by STI’s on-site Geotechnical Engineer. The Geotechnical

Engineer should perform shallow hand auger borings into the exposed native soils. Soft, sheared, disturbed, loose, or otherwise weak soils should be excavated as directed by the Geotechnical Engineer. Upon the Geotechnical Engineer’s observation and approval of the exposed native soils, the footings can then be constructed to rest on the competent native soils, or on engineered fill soils (soils that have been compacted and tested to a specified density) placed above the native soils to meet the design footing grade elevation(s). Refer to “Engineered Fill” recommendations on pages 8-9.

NOTE: Column pads placed next to the existing footings may require an alternate foundation system such as helical piers to avoid undermining the existing footings during excavation for the new footings.

FLOOR SLAB: Similar to the footings, it is our opinion that the existing “fill” soils and “topsoil” should not be used for support of the floor slab. Therefore, we recommend that site preparations for the floor slab area also consist of excavating the existing “fill” soils and “topsoil” to expose the underlying native clay “till” soils at the same minimum depths for that of the footings.

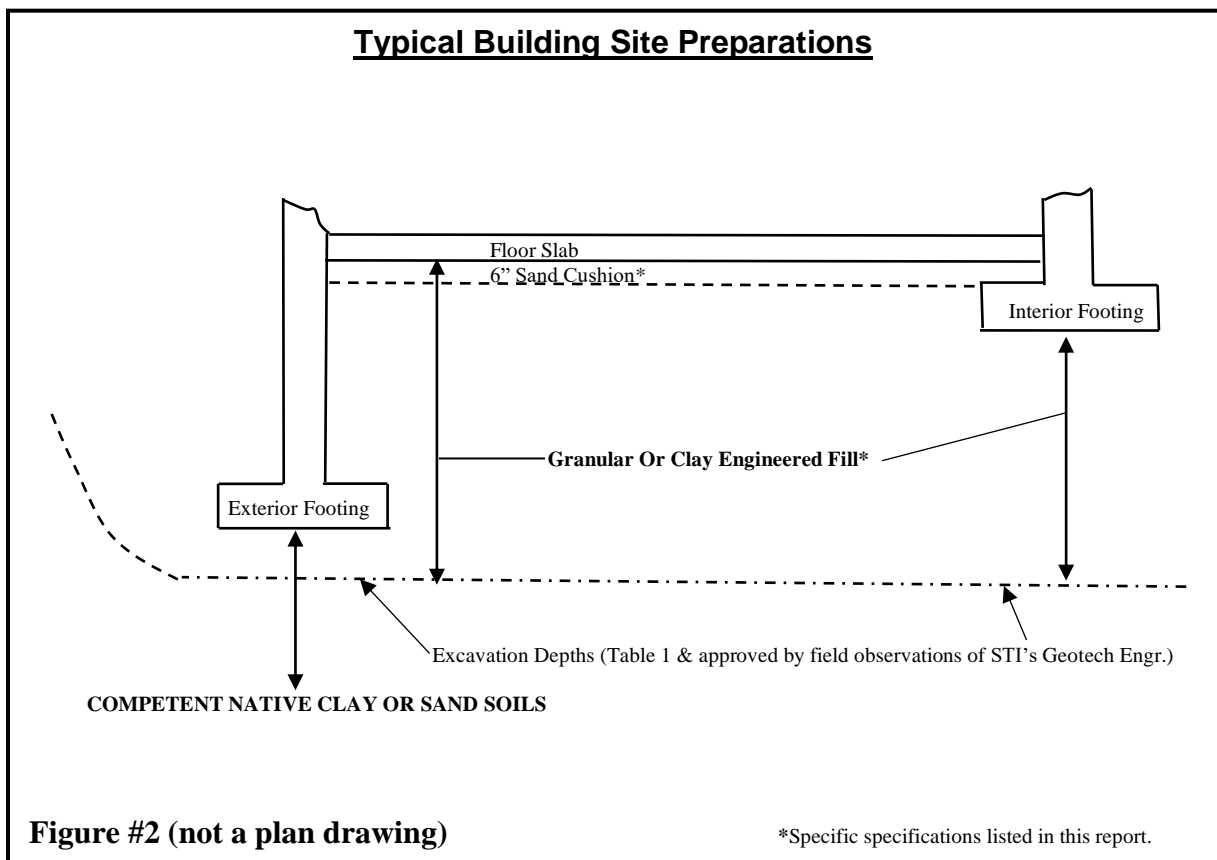
The approximate minimum recommended floor area excavation depths and corresponding elevations at each boring location are shown in Table 1 below. They are also noted on each of the attached boring logs. Please note that the required floor excavation depths may be significantly different at other locations at the site, and the on-site Geotechnical Engineer may require the floor excavation depths to be significantly different at those other locations.

TABLE 1 –FOOTING AND FLOOR AREA EXCAVATIONS

Boring #	<u>FOOTING AND FLOOR AREA EXCAVATION DEPTHS</u> Minimum Depths of Excavation Below Existing Grade (Feet)	<u>FOOTING AND FLOOR AREA EXCAVATION ELEVATIONS</u> Corresponding Minimum Excavation Elevations (Feet)*
1	6.5	92.6
2	7	91.8
3	7	91.3
4	7	89.8

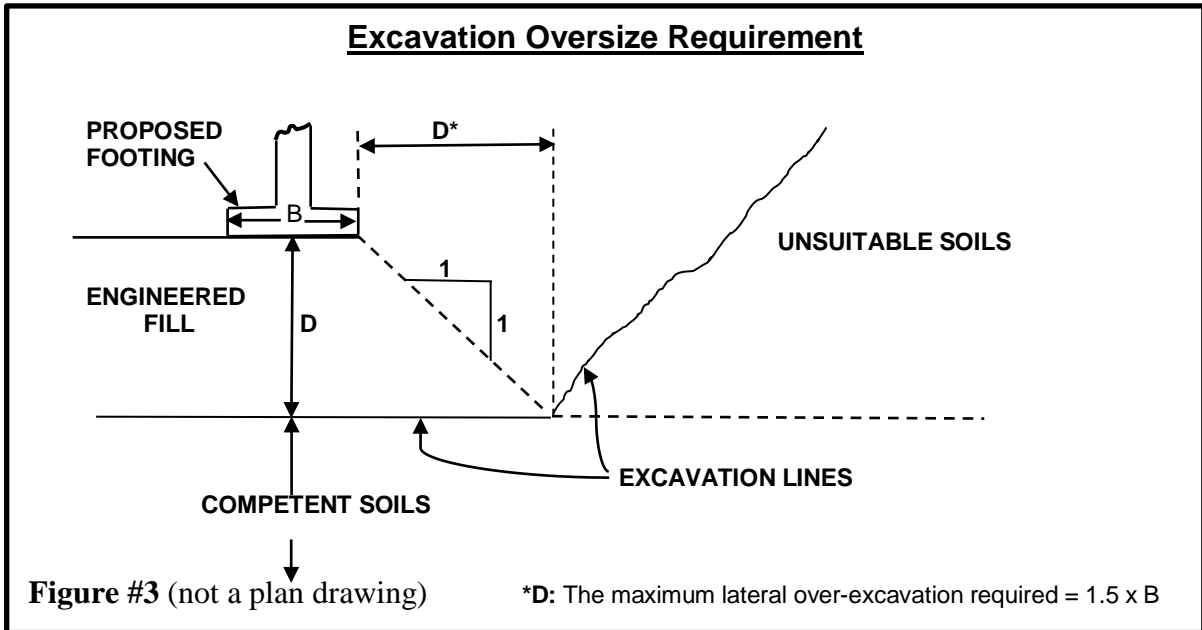
*Elevations based on the survey benchmark shown on the attached sketch.

During the floor area excavation, the exposed native soils at the bottom of the excavation should be observed by STI's on-site Geotechnical Engineer. The Geotechnical Engineer should perform shallow hand auger borings into the exposed soils. Soft, sheared, disturbed, loose, or otherwise weak soils should be excavated and replaced with engineered fill as directed by the Geotechnical Engineer. Upon the Geotechnical Engineer's observation and approval of the exposed native soils, engineered fill should be placed above the exposed competent native soils to meet the design floor grade elevation. Refer to the "Engineered Fill" recommendations listed on pages 8-9. Also, refer to Figure #2 below showing the "Typical Site Preparations."



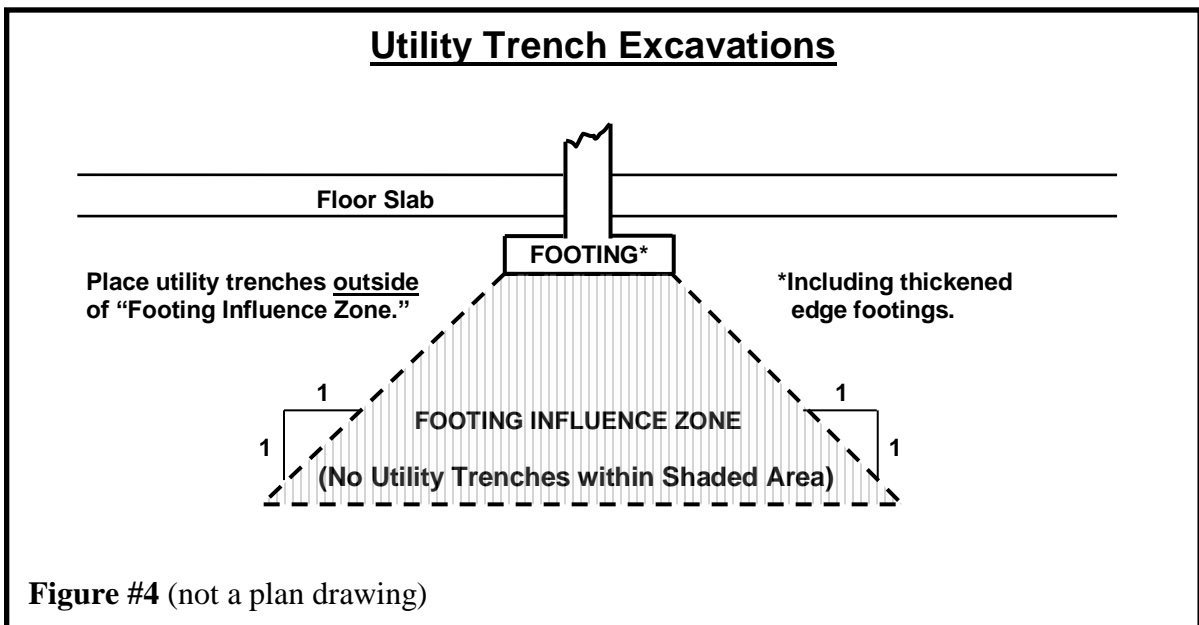
- **Excavation Oversize Requirements**

Engineered fill placed below the footings should be oversized one foot laterally for each foot of engineered fill placed below the footings (extend the excavation outwards from the outer edges of the footings a distance of 1 foot for every 1 foot of engineered fill placed below the footings). The maximum lateral over-excavation required is 1.5 times the width of the footing. Please refer to Figure #3 below illustrating the 1:1 excavation oversize requirement.



- **Utility Trenches**

Utility trenches within the building footprint (and in structural areas outside the building footprint) should be refilled with engineered fill. The engineered fill should be compacted and tested to the specified density listed on page 9. In addition, utility trenches should not be placed within the influence zone of the footings, including the influence zone of thickened edge footings. Please refer to Figure #4 below. If it is necessary to install a utility by crossing beneath an existing footing (new or old), that portion of the utility trench below the existing footing should be refilled with a lean concrete mix (flowable fill).





- **Geotechnical Engineer's Observations**

Soil types and strengths can sometimes vary around and in-between the borings. Some soils may not be as competent for support of the proposed building addition as those encountered in the borings. Therefore, we recommend that the soils exposed in the final footing and floor area excavations of the proposed structure(s) be observed in the field by a Geotechnical Engineer from Soil Technologies, Inc (STI). The Geotechnical Engineer will compare the exposed soils with the soils listed on the boring logs of this report to determine if they are the correct soil types and strengths. Once the type and strength of the soils exposed in the excavations are judged competent by STI's Geotechnical Engineer, the engineered fill, concrete footings, and floors can be placed as needed. STI's Geotechnical Engineer will provide a written report detailing the observations of the exposed soils in the footing and floor slab areas. **The general contractor or owner's representative should contact STI's Geotechnical Engineer to perform these field observations prior to the earthwork phase of the project.**

Note: This report and its recommendations are a two-step process. The first step is the implementation of the recommendations of this report during the design of the project. The second step is the implementation of these recommendations during construction. **The second step is critical to the success of the project, and it must include the field observations of the soils by STI's Geotechnical Engineer during the earthwork phase of the project.** It has been our experience that the lack of field observations by the Geotechnical Engineer during the earthwork phase of the project can result in oversight, in part or in whole, of the recommendations of the soils report. Therefore, the absence of our field observations of the soils during the earthwork phase, especially during the footing and floor area excavations, shall relieve us of the liability of the work performed during that phase of the project and its effect on related components. Also, refer to IBC Chapter 17 - "Special Inspections" Table 1705.6.

- **Subgrade Modulus**

Placement of engineered fill soils from the bottom of the excavation to the design slab elevation will generally increase the overall modulus. The amount of increase is dependent on the type and depth of engineered fill placed. A granular engineered fill would generally provide a higher modulus than clay engineered fill. For design purposes, we have provided estimated subgrade modulus ("K") values as listed below in Table 2. The subgrade modulus values are assumed to be at the surface of the described soil type compacted to at least 95% of the Standard Proctor density (ASTM: D698). Please note that these values are only estimates based on soil types and densities. "Plate Load Tests" should be performed to provide specific "K" values.

TABLE 2

<u>Soil Type</u> (Minimum 95% Compaction) and/or approved by the on-site Geotechnical Engineer)	<u>Depth of Engineered Sand Soils</u>	<u>Estimated Subgrade Modulus (pci)*</u>
Engineered Sand Soils over Lean Clay Soils	6” to 9”	185
Engineered Sand Soils over Lean Clay Soils	9” to 12”	230
Engineered Sand Soils over Lean Clay Soils	15” to 18”	265
Engineered Sand Soils over Lean Clay Soils	More than 20”	290

*Values should be reduced (up to 40%) for exterior pavements or slabs exposed to freeze thaw cycles.

• **Engineered Fill - Foundation and Floor Areas**

We recommend the following types of engineered fill and compaction of engineered fill.

NOTE: Soils are classified as sand if more than 50% (by weight) is retained above the #200 sieve.

6-inch or more sand cushion below floor slab (capillary break):	The final 6” or more of engineered fill placed directly beneath the floor slab) should consist of free draining sand (SP or SW) having a maximum gravel size of 1” and with less than 10% passing the #200 sieve by weight. The purpose of the sand cushion is to provide a working surface for the placement of concrete and also to serve as a capillary barrier.
Above and below the footings and below the floor slab, up to within 6 inches or more below the bottom of the floor slab (including utility trenches):	<p><u>If moist to dry soil conditions exist in the excavation,</u> use a granular engineered fill such as a pit run or processed sand or sand with gravel (SP, SW, SM, and SC). Also, a clay engineered fill such as a non-organic and non-expansive lean clay (CL) can be used. The pit run and processed sand should have a maximum gravel/cobble size of 3 inches and at least 13% passing the #40 sieve. The clay should have a liquid limit of less than 45.</p> <p><u>If wet or saturated soil conditions exist in the excavation,</u> a clean and medium to coarse grained sand or sand with gravel (SP or SW) will likely be required until at least 2 feet above the wet or saturated soil level in order to achieve the required compaction. The clean sand should have a maximum gravel/cobble size of 2 inches, 13% to 40% passing the #40 sieve, and less than 5% passing the #200 sieve. A 6 to 8-inch layer of a 3/8” or less rock can be placed at the bottom of the excavation for stabilization purposes.</p> <p><u>NOTE the following:</u></p> <ul style="list-style-type: none"> - The on-site, non-organic lean clay soils (brown and dark brown) are acceptable as CL engineered fill. - The on-site non-organic silty sand soils (brown and dark brown) are acceptable as sand (SM) engineered fill. - Organic soils (topsoil) should not be used for engineered fill.

<p>Compaction of engineered fill: (Less than 9 feet total thickness):</p>	<ul style="list-style-type: none"> - Below Footings <u>and in the footing influence zone (pg. 6):</u> - Below Floor Slabs: - Utility Trenches (inside & within 10' outside of the building): 	<p><u>Minimum % Compaction</u></p> <ul style="list-style-type: none"> ➤ 97% of the ASTM:D698* ➤ 97% of the ASTM:D698* ➤ Same as “Below Floor Slabs” <p><small>*Standard Proctor Density</small></p>
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• **Compaction Equipment and Placement of Engineered Fill**

Engineered fill should be compacted in maximum 12-inch loose lifts using heavy, self-propelled compaction equipment, or maximum 6-inch loose lifts using hand-operated compaction equipment. Smooth-faced, vibratory compaction equipment should be used for compaction of granular engineered fill (sand). Clay engineered fill should be placed at a moisture content ranging from -4% to +2% of the optimum moisture content as determined by the Standard Proctor (ASTM: D698). The moisture content of granular engineered fill should be such to achieve the specified compaction. The moisture content of the clay soils should be maintained until the placement of the footings and floor slabs. The engineered fill should be free of frost and should not be placed on frozen soils. Please refer to the attached “Precautions...During Cold Weather.”

2.3 Foundations

• **Allowable Soil Bearing Pressure**

In our opinion, the proposed structure can be supported on a shallow spread footing foundation system (column pads and/or strip footings). We recommend that the spread footings be designed using **an allowable soil bearing pressure of up to 2500 psf.**

The allowable soil bearing pressure listed above assumes that the site is prepared as recommended in section 2.2 Site Preparations and that the project is constructed as per the information and conditions listed in section 1.1 Project Information. **If the project information or conditions are changed, STI must be notified in writing for additional review and possibly revised recommendations.**

The allowable soil bearing pressure is based on our judgment of the soil conditions at the boring locations along with recommended compaction levels and our experience with similar soil conditions. The allowable soil bearing pressure is a net pressure and can be increased 30% for short-term loadings such as wind loads.

- **Foundation Settlement**

The recommendations in this report should provide a theoretical safety factor of at least 3.0 against localized shear failure of the footings. Long term total settlements of the building footings are estimated to be less than 1 inch with estimated differential settlements less than ½ inch over a 30-foot length.

The above estimated settlements are based on the above recommended soil bearing pressure, the site being prepared as recommended in section 2.2 Site Preparations, and the project being constructed as per the information and conditions listed in section 1.1 Project Information: ... **the finished floor elevations will match that of the east building and be at 100.0 feet, column loads will be a maximum of 150 kips (total dead and live loads) with continuous footing loads less than 4 kips/ft (total dead and live loads), etc.**

Please note that the total and differential settlement of the footings (and floor slab) could be significantly greater than the above estimates if improper construction practices are used. These practices may include but are not limited to: allowing snow or ice to be incorporated into the engineered fill soils, allowing the soils below the footings or floor to be saturated or freeze prior to or after their placement, inadequate compaction of engineered fill soils, supporting the footings or floor slab on expansive soils such as fat clay (CH) or on soils that were inadvertently loosened during construction, etc.

- **Soil/Concrete Sliding Friction**

For horizontal loads, we recommend a soil-concrete friction factor of 0.35. The frictional factor should be applied only to the base (bottom) of the concrete foundation units and only the net downward vertical load should be used to determine the friction. An appropriate safety factor should be applied to the calculated lateral values.

- **Frost Depth**

To avoid frost related movement of the footings of heated structures during their entire life, the exterior footings should be placed at or below a frost depth as per city code, or a minimum 4½ feet below finished grade. Interior footings of heated buildings can be placed at shallower depths provided they are protected from frost during and after construction. To avoid frost related movement of the footings of unheated enclosed structures, exterior canopies, etc., both the exterior and interior footings should be placed at least 5½ feet below the finished exterior grade or the floor slab, as appropriate.

For unheated floor slabs, some frost related movement of floor slabs should be expected unless measures are taken to limit frost related movement below the slab, such as rigid insulation sheeting or placement of free-draining granular fill. Generally, we anticipate that limited frost related movement of unheated interior floor slabs can be achieved if at least 36 inches of free-draining granular fill is placed immediately below the floor slab. No frost related movement is expected if at least 5½ feet of free-draining granular fill is placed immediately below the floor slab.

2.4 Exterior Backfill

- **Soil Type**

Assuming the absence of retaining or below grade basement or lower level walls, it is our opinion that the on-site or imported non-organic and non-expansive lean clay (CL) soils should be used for exterior backfill soils (fill soils placed outside the exterior foundation walls and adjacent areas). Fat clay soils (CH) can also be used but are not desired; and the Geotechnical Engineer should approve their use and placement. Utility trenches or other excavations leading to the building foundations or floor areas should also be backfilled with the on-site or imported non-organic and non-expansive lean clay soils. Alternatively, and less desirable, sand or silt soils could be used for exterior backfill. However, if circumstances require that sand or silt backfill is used within 10 feet of the proposed structure, an 18-inch compacted clay cap or an asphalt or concrete pavement should be placed at the surface of the backfill to help minimize surface water from reaching the foundation soils. (Please refer to Figure #5 on page 13.)

Organic soils (usually black colored) should not be used for exterior backfill, except for cover material. Also, soils that can expand, such as fat clay (CH), should not be used for backfill against retaining type structures or below slabs, sidewalks, driveways, etc.

- **Compaction and Placement of Exterior Backfill**

Exterior backfill soils placed along foundation walls and in adjacent areas such as beneath lawns, sidewalks, traffic areas, or in utility line trenches, should be compacted to the following minimum percent densities as listed in Table 3 below. Note: Exterior backfill soils placed within the “influence zone” below the footings should be compacted to the minimum densities listed for footings on page 9.

TABLE 3

<u>Compaction of Exterior Backfill</u>	Light Traffic Areas (autos, driveways, sidewalks, etc. - below granular base):	95% of the ASTM: D698*
	Heavy Truck Traffic Areas (below granular base):	97% of the ASTM: D698*
	Utility lines and other backfill within 10 feet of the proposed structure(s) except in traffic areas use above %.	95% of the ASTM: D698*
	Non-Traffic Areas (lawns, landscaping areas, etc.) greater than 10 feet of the proposed structure(s)	92% of the ASTM: D698*

*Standard Proctor Density

Exterior backfill soils should be compacted in maximum 12-inch loose lifts using heavy, self-propelled compaction equipment, or maximum 6-inch loose lifts using hand-operated compaction equipment. Clay exterior backfill soils should be placed at a moisture content ranging from -4% to +2% of the optimum moisture content as determined by the Standard Proctor. The moisture content of granular exterior backfill soils (sand) should be such to achieve the specified compaction. Smooth-faced, vibratory compaction equipment should be used for compaction of granular backfill soils. The backfill material should be free of frost and should not be placed on frozen soils. Please refer to the “Precautions...During Cold Weather” attached to this report.

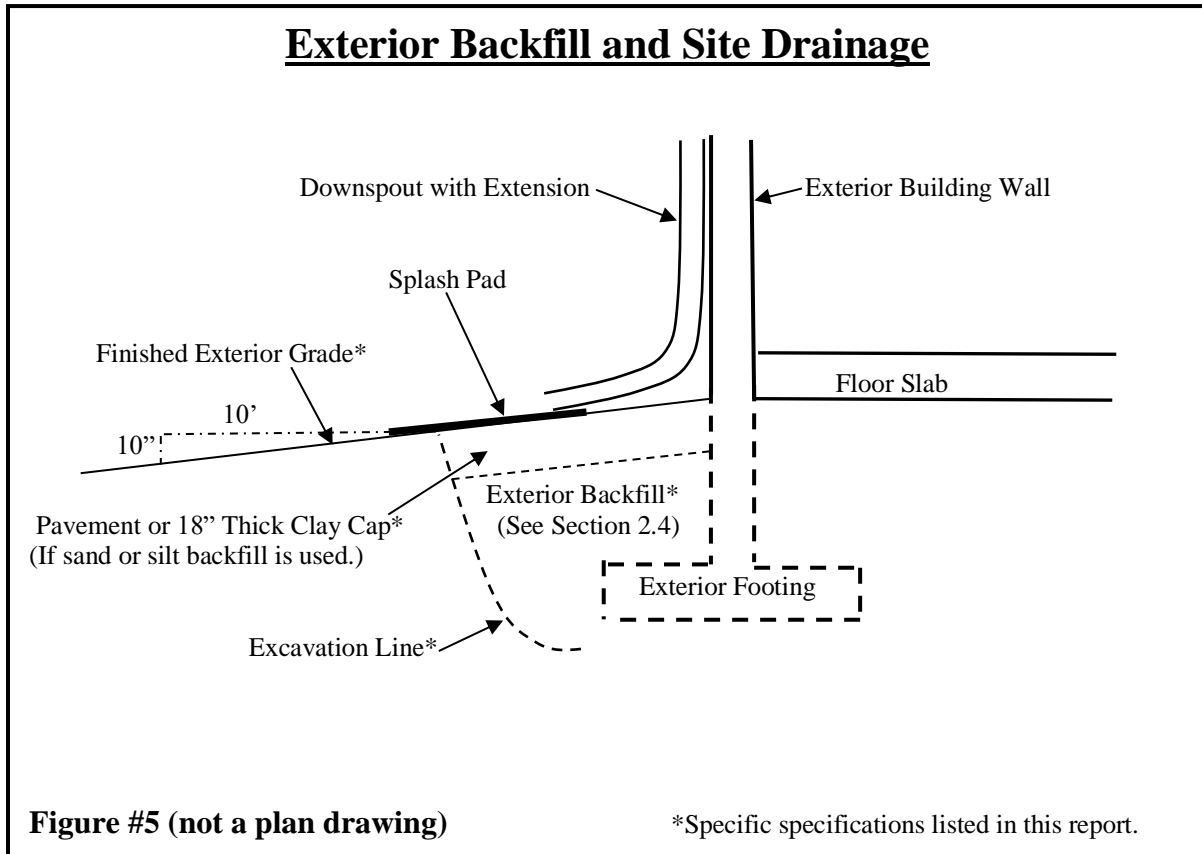
2.5 Site Drainage

- **Site Grading**

Proper drainage should be maintained during and after construction. General site grading should not allow water to pond in the building area or in the excavations. Any ponded water should be removed immediately. Finished grades around the perimeter of the structure should be sloped away from the structure with a minimum slope of 1 inch per foot for at least 10 feet beyond the excavation lines. (Please refer to Figure #5 below.) The slope can be reduced to ¼ inch per foot in areas that are completely surfaced and properly sealed with asphalt or concrete. The slope and proper drainage should be maintained throughout the life of the structure.

- **Roof Runoff**

Roof runoff water should be controlled by a system of downspouts and gutters with proper extensions to remove the runoff water away from the structure. The gutters and downspouts, as well as splash pads and extensions, should be maintained so that leakage does not occur adjacent to the structure. (Please refer to Figure #5 below.)



2.6 Pavement Recommendations

• **Soil Profile**

The boring logs suggest that the general soil profile in the area of the proposed pavement area (borings #5 - #9) consists of about 1 to 2.5 feet of sand and clay “fill” soils overlying native clay soils. More specifically, the borings along the west edge of the pavement area, close to the building (borings #5 & 7), suggest that organic clay “fill” soils exist from the surface down to about 1 foot. However, the borings along the east portion of the pavement area (borings #6 & 8) suggest that sand “fill” soils (possibly base course) exist from the surface down to about 1 foot. Thus, it appears that the sand “fill” soils in at least a good portion of the site could be excavated, stockpiled, and re-used as sub-base material for the new pavement section.

• **Subcutting**

We recommend that site preparations for the proposed pavement areas consist of the excavation (subcutting) of the existing clay and sand “fill” soils to a depth that would provide for the placement of the recommended pavement sections listed below. At a minimum, the top 12 inches of the existing surface soils (typically dark brown or black colored) should be excavated prior to



placement of any new base or subgrade materials. The purpose of the excavation of the top 12 inches is to remove the majority of the higher organic, contaminated, or loose soils that may exist at the surface of the parking lot site, and if desired, to stockpile the sand “fill” soils excavated from the areas of borings #6, #8, and #9 for possible later use as sub-base material. Final excavation depths should be determined in the field by a STI’s Geotechnical Engineer to verify that the necessary soils have been removed.

- **Scarify and Recompact**

Following the subcutting operations (minimum of 12 inches), we recommend scarifying the exposed subgrade soils to a depth of at least 12 inches and recompacting them to the following densities:

- Light-Duty Pavement: **Minimum of 95%** of Standard Proctor density (ASTM: D698).
- Heavy-Duty Pavement: **Minimum of 97%** of Standard Proctor density (ASTM: D698).

During the recompaction of the scarified subgrade soils, adequate stability of the subgrade soils must exist prior to the placement of additional subgrade soils and/or the pavement section. To help achieve stability, the moisture content of the subgrade soils at the time of scarifying/recompaction should be slightly below the optimum moisture content (-4% to optimum %) as determined by the Standard Proctor. Normally it is best to plan construction during mid to late summer to minimize the chance of high moisture soil conditions that inhibit compaction efforts.

- **Proof-Roll**

In addition to the scarifying/recompaction process, the final surface of the subgrade soils should be **proof-rolled** using heavy wheel load equipment such as a loaded truck or pay-loader. The proof-roll should be observed by STI’s on-site Geotechnical Engineer. Deflections or rutting of the subgrade soils by 1 inch or more should be reworked and moisture adjusted so that a deflection of less than 1 inch is achieved. If soft areas develop during scarifying/recompaction or proof-rolling and cannot be remedied, they should be removed and replaced with a granular fill (sand/gravel) or, alternatively, a non-organic lean clay fill having a liquid limit of 45 or less and a plasticity index between 14 and 30. The fill soil should be compacted to a density of at least 95% (Light-Duty Pavement) or at least 97% (Heavy-Duty Pavement) and at a moisture so that a deflection of less than 1 inch is achieved. The geotechnical engineer should document the proof-roll procedure and acceptance.



- **Geotextile Fabric**

If high soil moisture conditions, shallow utilities, etc. exist during construction and are such that the 95% or 97% compaction or the proof-roll deflection of the subgrade soils is not met, a high strength geotextile fabric such as Marafi's HP 370, or a geogrid such as Tensar's NX750 could be used as an alternative to the recompaction and proof-roll processes. The high strength fabric or geogrid could be used in combination with the pavement sections listed in Table 4 below. Please contact us if the compaction or proof-roll requirements are not met.

Even if the high strength geotextile fabric is not needed due to high soil moisture, shallow utilities, etc., it is our opinion that at least a light to medium weight woven geotextile fabric should be a consideration in the design of the pavement section. The purpose of a geotextile fabric is to help limit the clay and silt particles of the subgrade from migrating up into the base materials. This migration of the clay and silt particles often weakens the base materials and shortens the design life of the pavement section. The fabric should be placed below the granular base materials. Although it is not required to provide a typical pavement life for this site, it is our opinion that the geotextile fabric will extend the life of the pavement with fewer repairs. Please note that the "piping ratio" and "size ratio" of the geotextile fabric should be checked to verify that the type of fabric is appropriate for the particle sizes of the subgrade soils present at the site and the base material planned to be used.

- **Additional Subgrade Fill**

If additional subgrade fill is required to meet design grade elevations of the proposed pavement areas, we recommend a suitable subgrade material be used. Ideally, a granular (sand or gravel) material should be used. Alternatively, non-organic and non-expansive clay having a liquid limit of 45 or less and a plasticity index between 14 and 30 could be used. The subgrade fill soils should be placed in maximum 8-inch loose lifts and compacted to the following:

- Light Duty Pavement: **Minimum of 95%** of Standard Proctor density (ASTM: D698).
- Heavy Duty Pavement: **Minimum of 97%** of Standard Proctor density (ASTM: D698).

To help achieve adequate stability, the moisture content of the subgrade fill at the time of compaction should be below the optimum moisture content (-4% to optimum %) as determined by the Standard Proctor.

- **Base Material Specifications and Compaction**

We recommend the aggregate base course and granular subbase materials along with the bituminous asphalt used for the pavement sections meet the specifications outlined in North

Dakota Standard Specifications for Road and Bridge Construction. The aggregate base course and granular subbase material should be compacted to the following:

- Light Duty Pavement: **Minimum of 98%** of the Standard Proctor density (ASTM: D698).
- Heavy Duty Pavement: **Minimum of 100%** of the Standard Proctor density (ASTM: D698).

➤ **Pavement Sections**

We recommend the placement of the following minimum pavement sections listed in Table 4 below, as appropriate. The designs on based on the above recommended site preparations (excavation, scarify and recompact, etc.). Divergence from these site preparations may render the pavement sections inadequate.

TABLE 4

Pavement Description	Pavement Surfacing	Aggregate Base Course	Granular Subbase	Geotextile Fabric
<i>Light Duty Pavement</i> (mostly cars, light to medium trucks, light snow removal equipment) Asphalt: Concrete:	3" 5"	8" 6"	Optional ⁺	Consider a light to medium weight woven geotextile fabric.*
<i>Heavy Duty Pavement</i> (heavy trucks, heavy snow removal equipment, trash bin areas) Asphalt: Concrete:	5" 6"	8" 6"	Optional ⁺	

*High strength fabric may be required if subgrade soil compaction or proof-roll fails. See previous paragraphs.

⁺Not required but can be used to reach Aggregate Base Course grade elevation.

Note: Along with the 5 borings performed in the pavement area, we performed 5 DCP (Dynamic Cone Penetrometer) tests of the subgrade soils from 6 to 36 inches below the existing grades. The DCP tests were performed at boring locations #5, #6, and #8. The DCP tests results, along with the laboratory tests, were used in the design of the pavement sections. The pavement section designs listed are based on an estimated CBR value of about 5.0 % or higher, which in turn is based on the site preparations of the pavement area. Also, the pavement section designs are based on a 25-year pavement life and an estimated traffic count of up to 50 vehicles/day. The light-duty pavement assumes that about 7% of the traffic consist of light duty trucks having 3 axles or less. The heavy-duty pavement assumes that about 35% of the traffic consists of heavy trucks having 3 axles or more. The pavement sections are not applicable to equipment (machine) traffic that

exert wheel loads greater than ND Hwy legal load limits. Finally, the pavement section designs assume legal load limits during all 4 seasons of the year.

Please keep in mind that the basis of the above listed pavement section designs is to provide satisfactory support of the weaker areas of the pavement area as judged by the 5 soil borings, 3, DCP tests, and laboratory test data. However, other areas of the parking lot/driveway may be weaker than those encountered in the 5 soil borings. Hence, performing a significant number of DCP tests (dynamic cone penetrometer tests) should be considered during construction to verify that all of the prepared subgrade soils have reached a CBR of at least 5.0%. If, during construction, the minimum 5% CBR of the subgrade soils does not exist in a specific area of the proposed pavement, that area should be “reworked” (scarified, dried down, and recompacted) in order to increase the minimum CBR to 5%. Alternatively, instead of reworking the subgrade soils to achieve the minimum CBR 5%, the base material gravel section thickness should be increased in that specific area to meet the design.

- **Concrete Pavement**

The concrete paving products should be composed of a quality mix. The mix should have a proven success record, or a mix design should be established for proper proportions of aggregate, cement, water, and any admixtures. The concrete should be handled, placed, and cured according to current **ACI Guidelines and Specifications for Exterior Concrete**. The concrete should have a minimum compressive strength of 4000 psi, be placed with a maximum slump of 3 inches, and should have air entrainment between 5% and 7%.

Relative to saw joints, a maximum width in the longitudinal and transverse directions should be provided as per ACI guidelines. All saw joints should be installed as soon as the surface is sufficiently hard to support equipment and within a maximum of 24 hours of casting. All joints should be adequately sealed with proper joint sealer.

- **Subgrade and Surface Drainage**

We recommend that extra care be taken in the design and construction process to help ensure that adequate surface and subgrade drainage is maintained throughout the paved areas. The pavement surface should be uniformly sloped to facilitate its drainage. In addition, the subgrade surface should be uniformly sloped to facilitate drainage of the base material within the pavement system and to avoid any ponding of water beneath the pavement. Edge drains, center drain tile, and/or center storm sewer drains should be used where possible. The purpose of the drainage is to minimize saturation of the subgrade soils and to minimize potential distress due to moisture and

frost related movement of the underlying soils. Timely maintenance such as crack filling, seal coats, and localized patching should be routinely performed in all pavement areas.

- **Frost and Moisture Related Movement**

The clay soils encountered at the site likely have a moderate susceptibility of frost related movement and therefore, some frost related distress (cracking) of the asphalt and concrete should be expected. Even if the asphalt or concrete pavement is properly placed and adequately compacted on aggregate base materials and stable subgrade soils, pavements will still experience cracking after the first year or two. The potential of distress can be minimized by 1) adding a significant depth of relatively clean granular subbase material below the aggregate base course, 2) compacting the subgrade soils to greater depths, and 3) increasing the percent compaction of the subgrade soils. Also, we recommend that a regularly scheduled maintenance program consisting of patching of cracks and local distressed areas be performed. Seal coating of the asphalt pavement surface after 3 to 5 years typically prolongs the pavement life.

- **Utility Trenches**

We recommend that utility trench backfill soils be placed in maximum 8-inch loose lifts and compacted to a **minimum of 95%** of the Standard Proctor density (ASTM: D698) up to but not including the top 24 inches of the pavement subgrade soils. The top 24 inches should be compacted to a **minimum of 95% or 97%** of the Standard Proctor density as appropriate for light and heavy duty pavement sections. The top 24 inches of the subgrade fill should be at or below the optimum moisture content (normally -4% to +0%) as determined by the Standard Proctor. The trench backfill soils below 24 inches should be placed at a moisture content of -4% to +2 % as determined by the Standard Proctor.

3.0 CONSTRUCTION AND DESIGN CONSIDERATIONS

3.1 Construction Considerations

- **Soil Disturbance & Moisture Changes**

The soils encountered at the site can be sensitive to disturbance and may experience strength loss under the influence of construction traffic and/or additional moisture. Construction traffic in areas where these soils are used for structural or floor support should be limited. If self-propelled compaction equipment is used, extra care should be taken so as not to disturb (weaken) the native soils due to excess weight and/or vibration of the equipment. If the soil used for structural, floor, or wheel traffic support becomes frozen, desiccated, saturated, or is disturbed,

the affected soil should be removed; or if the disturbance is shallow, recompacted in-place prior to placement of additional fill or structural units.

Also, the site preparations should include complete removal of all remnants of previously existing structures, structural units, utilities, tree roots, etc. Excavations to remove these items, or intrusions (accidental, deliberate, or otherwise) should be backfilled with engineered fill and compacted to the specified density listed on page 9.

The excavations should be left open a minimal amount of time to prevent strength loss of these soils by sluffing of soils, ponding of water, or changes in their in-situ moisture content. In addition, surface drainage away from the excavations should be provided during construction. Also, the excavations should be done with an excavation bucket having a smooth cutting edge.

- **Dewatering**

The footing and floor excavations may extend near or below the groundwater level. Thus, dewatering of the excavations (lowering the groundwater level within and below the bottom of the excavations) may be required for proper placement of engineered fill and/or the footings and floor slab systems. Please refer to the groundwater measurements listed at the bottom of the attached boring logs.

The excavations and dewatering must be such as to provide for physical access and observations of the soils at the bottom of the excavations, and for proper compaction of the engineered fill soils at the bottom of excavations. Dewatering will also help limit the potential softening or loosening of the native clay soils prior to placement of the engineered fill and the footings. Generally, we anticipate that the de-watering will be able to be accomplished using typical sump-pump methods.

3.2 Design Considerations

- **Polyethylene Vapor Membrane (Slab-on-grade)**

We recommend that consideration be given to placing a polyethylene vapor membrane (retarder) beneath the floor slab, especially if there are areas where moisture sensitive flooring materials, or impermeable floor coatings, or moisture sensitive equipment or product are planned. If used, consideration should be given to the potential of curling of the concrete floor due to the presence of the membrane. Placing the membrane at least 2 inches beneath the surface of the sand cushion can help to minimize the potential for curling of the concrete floor. The architect or structural



engineer of record should decide on the use and placement of the membrane. The slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder. Also refer to IBC section 1907.

- **Seismic Category**

Based on IBC 2021, the subsurface conditions encountered at the site, and our experience with other general geologic conditions for this area, it is our opinion that Site Class D should be used to determine site coefficients and seismic design category.

- **Structural Movement Considerations**

Differential movement (vertical and horizontal) may occur between the existing structure and proposed addition and should be considered in design to avoid distress. Also, consideration should be given to movement of underground piping between the structures such that deflections in alignment do not result in breakage or distress.

- **Existing Structure**

If the foundations for the proposed building addition are placed next to the existing structure, care should be taken not to undermine the foundations of the existing structure. Also, to prevent additional loading on the existing foundations, the new foundations should rest at or below the depth of the existing foundations. If the new foundations rest within a 45° envelope below the existing foundations, the new foundations may need to be designed for increased loading caused by the overlying pressures of the existing footings. Please contact us if this situation develops in the design.

- **Moisture or Frost Related Movement**

Exterior architectural features, slabs, and utilities can experience moisture or frost related movement which can result in distress. The existing clay soils likely have a moderate susceptibility of frost related movement. The risk of this potential movement and subsequent distress can be reduced (but not necessarily eliminated) by:

1. The use of control joints.
2. The use of self-adjusting utility connections.
3. Allowing for movement of exterior features attached to structural elements.
4. The use of significant depths of clean granular fill beneath slabs-on-grade (floors), driveways, sidewalk, etc.
5. Proper drainage away from exterior slabs-on-grade.
6. Placement of rigid insulation sheeting under at least 10 inches of free draining granular fill.



- **OSHA**

Excavations must comply with the requirements of local, state, federal and other prescribed safety regulations, e.g., OSHA Part 1926, Subpart P, "Excavations." Reference to these requirements should be included in the project specifications.

4.0 EXCAVATION OBERVATION AND TESTING

The recommendations contained in this report are based on the subsurface conditions found at the boring locations. It is possible that there are soil conditions on the site that were not represented by the borings. Consequently, on-site observation by a qualified Geotechnical Engineer during construction is considered integral to the successful implementation of the recommendations.

We recommend that a Geotechnical Engineer from Soil Technologies, Inc. be on-site during the excavation operations. The engineer will judge if the soils exposed at the bottom and along the sidewalls of the excavations are adequate for support of the floor slab and for the foundations designed with the allowable soil bearing pressure recommended in this report. The Geotechnical Engineer should also be on-site immediately prior to placement of the sand cushion and reinforcing steel of the floor slab to verify that the floor area soils are not frozen, rutted, desiccated, saturated and/or otherwise disturbed. In addition, we recommend that density testing be performed within the sequence of the engineered fill.

5.0 GENERAL EXPLORATION INFORMATION

5.1 Scope of Exploration

We have conducted a soil exploration program for the proposed project. The scope of our services under this exploration is limited to the following:

1. To perform soil borings to explore the subsurface soil and groundwater conditions.
2. To perform nominal laboratory tests to aid in judging the soil properties.
3. To provide a geotechnical engineering report including the results of the field and laboratory tests as well as geotechnical engineering opinions and recommendations that are relative to the project.

Nine standard penetration test borings were performed at the site on November 20th, 2024. The borings were performed at the locations shown on the attached sketch. Some settlement of the soils used to fill the open bore holes should be anticipated and closure of the holes is the responsibility of the client or property owner.

5.2 Site Surface Conditions

The site of the proposed building construction is located between two school buildings along the south side of 2nd Street N, immediately southwest of 4th Ave. N in Ellendale, ND. The site is bordered on the east, west, and south by school buildings and on the north by 2nd Street N. The site surface at the time of our soil borings consisted of gravel. The overall general topography of the site is relatively level. The ground elevations at the boring locations were referenced to the survey benchmark (BM) shown on the attached sketch. The elevations are listed at the top of the attached boring logs.

5.3 Site Subsurface Conditions

The subsurface conditions encountered at each boring location are illustrated on the boring logs attached to this report. The logs also indicate the possible geologic origin of the materials encountered (alluvium, till, lacustrine etc.). A description of the general soil profile is also provided in section **2.1 Discussion**. We wish to point out that the subsurface conditions at other times and locations at this site may differ from those found at our boring locations. If different subsurface conditions are encountered during construction, it is necessary that you contact us so that our recommendations can be reviewed.

5.4 Water Levels

Observations for subsurface groundwater were made at the boring locations during our field operations. Groundwater was encountered at the boring locations during our sampling operations. Specific information relative to the groundwater observations is shown at the bottom of the attached boring logs.

The absence or present level of groundwater in the borings may not represent the actual static groundwater levels. In order to accurately determine the static groundwater level, observations over an extended period are usually required. Such periods of observation are normally not available in a typical soil exploration program. Seasonal and annual fluctuations of the groundwater levels should be expected to occur. It is possible that the subsurface groundwater levels during or after construction could be significantly different than at the time the borings were performed.

5.5 Laboratory Test Program

Soil samples were selected for laboratory tests to determine the engineering and index properties. Where applicable, the tests were performed in accordance with the American Society for Testing and Materials (ASTM) procedures. The test results are shown on the boring logs opposite the samples upon which the tests were made or, they are attached.

6.0 LIMITATIONS, REVIEW, USE, AND PURPOSE OF REPORT

- **Limitations**

The data obtained from the sampling and testing of the soils encountered at the boring locations are the basis of the recommendations submitted in this report. However, variations can occur between these borings and between the samples. Thus, no exploration program can totally reveal the exact subsurface conditions for the entire site. If the subsurface conditions encountered at the time of construction differ from those represented by our borings, it is necessary to contact us so that our opinions and recommendations can be reviewed. Differing subsurface conditions may result in altering our recommendations, which may affect construction costs. It is suggested that a contingency be provided for this purpose.

- **Review of Report**

This report is founded on the information and conditions listed in this report for design of the proposed structure(s). We recommend that we be retained to briefly review the geotechnical aspects of the final design and specifications to determine whether any changes in design may have had an effect on the validity of the recommendations contained in this report, and whether our recommendations have been correctly communicated so that their intent has been implemented in the design and specifications. Divergence from our recommendations by the design, specifications, or field applications shall relieve us of the responsibility of that portion of the project and its effect on related components unless our written agreement with such divergence has been obtained. Also, we recommend that this report is provided to the owner(s) along with the architect(s), engineer(s), contractor(s), etc. chosen for design and construction of the project.

- **Use of Report**

This report is intended for the Client's sole use and benefit and solely for the Client's use in the design and construction of the proposed project described herein and in preparation of construction documents. The data, analysis, and recommendations in this report may not be appropriate for extensions of the proposed project or for other projects or purposes. Thus, this



report shall not be used or relied on by persons or entities for extensions of the proposed project or for other projects or purposes. Parties contemplating extensions of the proposed project or for other projects or purposes must contact us for additional review. In the absence of our written review and approval, we make no representation and assume no responsibility for extensions of the proposed project or for other projects or purposes. Also, this report is not a bidding document and is only an aid in the design and construction of the proposed project. Contractors and others involved in the project must draw their own conclusions regarding the site conditions and construction methods.

- **Purpose of Report**

The purpose of this report is to present the results of our field and laboratory tests as well as our geotechnical engineering review and recommendations for the project. Our work is intended for geotechnical purposes only and not to verify the presence or extent of any contamination at the site. If environmental information is desired, an environmental assessment should be conducted.

7.0 STANDARD OF CARE

The recommendations contained in this report represent our professional opinions. These opinions were arrived at in accordance with currently accepted engineering procedures at this time and location. Other than this, no other representation, guarantee, or warranty, either expressed or implied, is made.

This report was prepared by:

Kim E. Stoecker, PE
President

Proposed School Addition
Ellendale Public School
Ellendale, ND
STI #24-1896



**Proposed School Addition
Ellendale Public School
Ellendale, ND
STI #24-1896**



BORING LOG

STI JOB #: 24-1896 **Project:** School Building Addition **BORING #:** 1
Location: Ellendale, ND Sheet 1 of 1

Latitude (North)= Longitude (West)= **SURFACE ELEVATION =** 99.1

Depth (ft.)	Elev. (ft.)	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	Water Level	N. Value	SAMPLE		LABORATORY TESTS									
						Sample No.	Sample Type	Moisture (%)	Dry Density (pcf)	Pocket Pen (tsf)	Qu (psf)	Liquid Limit	Plastic Limit	200 Sieve (%)			
2	97.1	Fill, Silty Sand with Gravel, dark brown, moist, frozen	FILL		94	1	SPT										
4	95.1	Fill, Sandy Lean Clay, a little Gravel, dark brown and brown, moist			8	2	SPT										
6.5	92.6	Organic Lean Clay, black, moist (CL-OL)	TOPSOIL		7	3	SPT										
		Lean Clay with Sand, a little Gravel, brown mottled and gray, moist, firm to soft to stiff (CL) Slight Hydrocarbon (Fuel) odor from 6.5' to 16'	TILL	▼	7	4	SPT										
					4	5	SPT 3TW	16	110		2200						
					9	6	SPT										
16	83.1				14	7	SPT										
		END OF BORING															

Footing & Floor Areas: Excavate the existing "Fill" soils and "Topsoil" to expose the native clay "Till" soils at 6.5 feet below existing grade. Final excavation depth to be approved by STI's on-site Geotechnical Engineer. Place engineered fill if needed to meet the design footing and floor grade elevations.

WATER LEVEL MEASUREMENTS						▼		Boring Started: 11/20/24 at	
								Boring Completed: 11/20/24 at	
DATE:	TIME:	SAMPLED TO:	CAVE IN:	CASING:	DEPTH:	Drilling Method: to			
11/20/24	12:53	16'	13'		7.5'	Drilling Method: 3 1/4" HSA 0 to 14.5'			
						Jet with Drilling Mud: to			
						Hammer Type: Auto Hammer (140 lb.)			
						Crew Chief: M.S. Logged By:			
						Backfill Method:			

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BORING LOG

STI JOB #: 24-1896		Project: School Building Addition		BORING #: 2												
		Location: Ellendale, ND		Sheet 1 of 1												
Latitude (North)=		Longitude (West)=		SURFACE ELEVATION = 98.8												
Depth (ft.)	Elev. (ft.)	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	Water Level	N. Value	SAMPLE		LABORATORY TESTS								
						Sample No.	Sample Type	Moisture (%)	Dry Density (pcf)	Pocket Pen (tsf)	Qu (psf)	Liquid Limit	Plastic Limit	200 Sieve (%)		
1	97.8	Fill, Silty Sand with Gravel, dark brown, moist, frozen	FILL		16	1	SPT									
		Fill, Sandy Lean Clay, a little Gravel, dark brown and brown, moist				7	2	SPT								
4	94.8	Organic Lean Clay, black, moist, (CL-OL) Hydrocarbon (Fuel) odor	TOPSOIL			6	3	SPT								
7	91.8	Lean Clay with Sand, a little Gravel, brown and dark gray and gray, moist, stiff to firm to stiff (CL) Hydrocarbon (Fuel) odor from 7' to 16'	TILL	▼		10	4	SPT								
							5	3TW	21	105		4300				
							7	SPT								
							7	SPT								
16	82.8	END OF BORING				10	8	SPT								
WATER LEVEL MEASUREMENTS				▼	Boring Started: 11/20/24 at											
					Boring Completed: 11/20/24 at 12:41											
DATE:	TIME:	SAMPLED TO:	CAVE IN:	CASING:	DEPTH:	Drilling Method: to										
11/20/24	12:52	16'	12'		9'	Drilling Method: 3 1/4" HSA 0 to 14.5'										
						Jet with Drilling Mud: to										
						Hammer Type: Auto Hammer (140 lb.)										
						Crew Chief: M.S. Logged By:										
						Backfill Method:										
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BORING LOG

STI JOB #: 24-1896 **Project:** School Building Addition **BORING #:** 3
Location: Ellendale, ND Sheet 1 of 1

Latitude (North)= _____ Longitude (West)= _____ SURFACE ELEVATION = 98.3

Depth (ft.)	Elev. (ft.)	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	Water Level	N. Value	SAMPLE		LABORATORY TESTS								
						Sample No.	Sample Type	Moisture (%)	Dry Density (pcf)	Pocket Pen (tsf)	Qu (psf)	Liquid Limit	Plastic Limit	200 Sieve (%)		
2	96.3	Fill, Silty Sand with Gravel, dark brown, moist, frozen	FILL		14	1	SPT	12								39
4	94.3	Fill, Sandy Lean Clay, a little Gravel, dark brown and brown, moist			8	2	SPT									
5.5	92.8	Organic Lean Clay, black, moist (CL-OL)	TOPSOIL		4	3	SPT									
7	91.3	Lean Clay, olive, moist (CL)	FINE ALLUVIUM	▼												
		Lean Clay with Sand, a little Gravel, brown and gray, moist, firm to stiff (CL) Hydrocarbon (Fuel) odor from 7' to 14'	TILL		7	4	SPT	22	105	1.4						
					9	5	SPT									
					11	6	SPT									
16	82.3				10	7	SPT									
		END OF BORING														

Footing & Floor Areas: Excavate the existing "Fill" soils, "Topsoil" & native clay "Alluvium" soils to expose the native clay "Till" soils at 7 feet below existing grade. Final excavation depth to be approved by STI's on-site Geotechnical Engineer. Place engineered fill if needed to meet the design footing and floor grade elevations.

WATER LEVEL MEASUREMENTS						▼		Boring Started: 11/19/24 at _____	
								Boring Completed: 11/19/24 at 17:23	
DATE:	TIME:	SAMPLED TO:	CAVE IN:	CASING:	DEPTH:	Drilling Method: _____ to _____			
11/20/24	16:40	16'	11'		6'	Drilling Method: 3 1/4" HSA 0 to 14.5'			
						Jet with Drilling Mud: _____ to _____			
						Hammer Type: Auto Hammer (140 lb.)			
						Crew Chief: M.S. Logged By: _____			
						Backfill Method: _____			

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BORING LOG

STI JOB #: 24-1896 **Project:** School Building Addition **BORING #:** 4
Location: Ellendale, ND Sheet 1 of 1

Latitude (North)= _____ Longitude (West)= _____ SURFACE ELEVATION = 96.8

Depth (ft.)	Elev. (ft.)	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	Water Level	N. Value	SAMPLE		LABORATORY TESTS									
						Sample No.	Sample Type	Moisture (%)	Dry Density (pcf)	Pocket Pen (tsf)	Qu (psf)	Liquid Limit	Plastic Limit	200 Sieve (%)			
1.3	95.5	Fill, Silty Sand with Gravel, dark brown, moist, frozen	FILL		12	1	SPT	11								22	
		Fill, Sandy Lean Clay, a little Gravel, dark brown, moist			11	2	SPT										
4	92.8	Fill, Lean Clay, black and gray, (possibly disturbed Topsoil)			6	3	SPT										
7	89.8	Lean Clay with Sand, a little Gravel, brown and gray, moist, firm to stiff (CL) Hydrocarbon (Fuel) odor from 7' to 14'	TILL	▼	5	4	SPT	25	104	0.8							
					10	5	SPT										
					10	6	SPT										
16	80.8	END OF BORING			9	7	SPT										

Footing & Floor Areas: Excavate the existing "Fill" soils and "Topsoil" to expose the native clay "Till" soils at 7 feet below existing grade. Final excavation depth to be approved by STI's on-site Geotechnical Engineer. Place engineered fill if needed to meet the design footing and floor grade elevations.

WATER LEVEL MEASUREMENTS						▼	Boring Started: 11/20/24 at _____		
							Boring Completed: 11/20/24 at _____ 17:00		
DATE:	TIME:	SAMPLED TO:	CAVE IN:	CASING:	DEPTH:		Drilling Method: _____ to _____		
11/20/24	16:44	16'	12.5'		8.5'		Drilling Method: 3 1/4" HSA 0 to 14.5'		
							Jet with Drilling Mud: _____ to _____		
							Hammer Type: Auto Hammer (140 lb.)		
							Crew Chief: M.S. Logged By: _____		
							Backfill Method: _____		

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BORING LOG

STI JOB #: 24-1896		Project: School Building Addition		BORING #: 5												
		Location: Ellendale, ND		Sheet 1 of 1												
Latitude (North)=		Longitude (West)=		SURFACE ELEVATION = 99.6												
Depth (ft.)	Elev. (ft.)	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	Water Level	N. Value	SAMPLE		LABORATORY TESTS								
						Sample No.	Sample Type	Moisture (%)	Dry Density (pcf)	Pocket Pen (tsf)	Qu (psf)	Liquid Limit	Plastic Limit	200 Sieve (%)		
1.5	98.1	Fill, Organic Sandy Lean Clay with Gravel, black and dark brown, moist, frozen	FILL		11	1	SPT									
3	96.6	Sandy Lean Clay, a trace of Gravel, brown, moist, stiff (CL)	TILL		14	2	SPT									
6	93.6	Lean Clay with Sand, a little Gravel, brown mottled and gray, moist, stiff (CL)			9	3	SPT									
		END OF BORING														
WATER LEVEL MEASUREMENTS				▼	Boring Started: 11/20/24 at											
					Boring Completed: 11/20/24 at 15:16											
DATE:	TIME:	SAMPLED TO:	CAVE IN:	CASING:	DEPTH:	Drilling Method:										
11/20/24						Drilling Method: 3 1/4" HSA 0 to 4.5'										
						Jet with Drilling Mud: to										
						Hammer Type: Auto Hammer (140 lb)										
						Crew Chief: M.S. Logged By:										
						Backfill Method:										
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BORING LOG

STI JOB #: 24-1896		Project: School Building Addition			BORING #: 6										
		Location: Ellendale, ND			Sheet 1 of 1										
Latitude (North)=		Longitude (West)=		SURFACE ELEVATION = 100.6											
Depth (ft.)	Elev. (ft.)	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	Water Level	N. Value	SAMPLE		LABORATORY TESTS							
						Sample No.	Sample Type	Moisture (%)	Dry Density (pcf)	Pocket Pen (tsf)	Qu (psf)	Liquid Limit	Plastic Limit	200 Sieve (%)	
1	99.6	Fill, Silty Sand with Gravel, brown, moist, frozen	FILL		6	1	SPT								
		Lean Clay with Sand, olive and gray, moist, soft to firm (CL)	FINE ALLUVIUM			2	2	SPT	10	103	3.2				
						5	3	SPT	12		1.9				
6	94.6	END OF BORING													
WATER LEVEL MEASUREMENTS				▼	Boring Started: 11/20/24 at										
					Boring Completed: 11/20/24 at 15:26										
DATE:	TIME:	SAMPLED TO:	CAVE IN:	CASING:	DEPTH:	Drilling Method:									
11/20/24						Drilling Method: 3 1/4" HSA 0 to 4.5'									
						Jet with Drilling Mud:									
						Hammer Type: Auto Hammer (140 lb)									
						Crew Chief: M.S. Logged By:									
						Backfill Method:									
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BORING LOG

STI JOB #: 24-1896 **Project:** School Building Addition **BORING #:** 7
Location: Ellendale, ND Sheet 1 of 1

Latitude (North)= _____ Longitude (West)= _____ SURFACE ELEVATION = 100.0

Depth (ft.)	Elev. (ft.)	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	Water Level	N. Value	SAMPLE		LABORATORY TESTS									
						Sample No.	Sample Type	Moisture (%)	Dry Density (pcf)	Pocket Pen (tsf)	Qu (psf)	Liquid Limit	Plastic Limit	200 Sieve (%)			
1	99.0	Fill, Organic Sandy Lean Clay, a little Gravel dark brown, moist, frozen	FILL		9	1	SPT										
2.5	97.5	Fill, Silty Sand, a trace of Gravel, dark brown, moist															
4	96.0	Lean Clay with Sand, brown and gray, moist, soft (CL)	FINE ALLUVIUM		4	2	SPT	11	112	3.5							
6	94.0	Sandy Lean Clay, a trace of Gravel, brown mottled and gray, moist, firm (CL)	TILL		8	3	SPT										
		END OF BORING															

WATER LEVEL MEASUREMENTS ▼						Boring Started: 11/20/24 at _____	
						Boring Completed: 11/20/24 at 15:06	
DATE:	TIME:	SAMPLED TO:	CAVE IN:	CASING:	DEPTH:	Drilling Method: _____ to _____	
11/20/24						Drilling Method: 3 1/4" HSA 0 to 4.5'	
						Jet with Drilling Mud: _____ to _____	
						Hammer Type: Auto Hammer (140 lb)	
						Crew Chief: M.S. Logged By: _____	
						Backfill Method: _____	

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BORING LOG

STI JOB #: 24-1896		Project: School Building Addition			BORING #: 8											
		Location: Ellendale, ND			Sheet 1 of 1											
Latitude (North)=		Longitude (West)=			SURFACE ELEVATION = 100.8											
Depth (ft.)	Elev. (ft.)	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	Water Level	N. Value	SAMPLE		LABORATORY TESTS								
						Sample No.	Sample Type	Moisture (%)	Dry Density (pcf)	Pocket Pen (tsf)	Qu (psf)	Liquid Limit	Plastic Limit	200 Sieve (%)		
1	99.8	Fill, Silty Sand, a little Gravel, dark brown, moist	FILL	5	3	1	SPT	12	8	4.4					29	
		Lean Clay with Sand, light brown, moist, soft (CL)	FINE ALLUVIUM													
	5	95.8					3	2	SPT							
6	94.8	Silty Sand, fine grained, light brown, moist, very loose (SM)	MIXED ALLUVIUM	9	3	SPT										
		END OF BORING														
WATER LEVEL MEASUREMENTS				▼	Boring Started: 11/20/24 at Boring Completed: 11/20/24 at 14:55											
DATE:	TIME:	SAMPLED TO:	CAVE IN:	CASING:	DEPTH:	Drilling Method: to Drilling Method: 3 1/4" HSA 0 to 4.5' Jet with Drilling Mud: to Hammer Type: Auto Hammer (140 lb) Crew Chief: M.S. Logged By: Backfill Method:										
11/20/24																
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BORING LOG

STI JOB #: 24-1896		Project: School Building Addition		BORING #: 9											
		Location: Ellendale, ND		Sheet 1 of 1											
Latitude (North)=		Longitude (West)=		SURFACE ELEVATION = 101.8											
Depth (ft.)	Elev. (ft.)	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	Water Level	N. Value	SAMPLE		LABORATORY TESTS							
						Sample No.	Sample Type	Moisture (%)	Dry Density (pcf)	Pocket Pen (tsf)	Qu (psf)	Liquid Limit	Plastic Limit	200 Sieve (%)	
6	95.8	Fill, Silty Sand with Gravel, brown and black, moist, frozen	FILL		19	1	SPT								
					26	2	SPT								
					21	3	SPT								
		END OF BORING													
WATER LEVEL MEASUREMENTS				▼		Boring Started: 11/20/24 at									
						Boring Completed: 11/20/24 at 15:42									
DATE:	TIME:	SAMPLED TO:	CAVE IN:	CASING:	DEPTH:	Drilling Method:									
11/20/24						Drilling Method: 3 1/4" HSA 0 to 4.5'									
						Jet with Drilling Mud: to									
						Hammer Type: Auto Hammer (140 lb.)									
						Crew Chief: M.S. Logged By:									
						Backfill Method:									
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FIELD EXPLORATION PROCEDURES

Soil Sampling

Soil sampling was performed in accordance with ASTM: D1586. Using this procedure, a 2" O.D. split barrel sampler is driven into the soil by a 140-lb. weight (hammer) falling 30". After an initial set of 6", the number of blows required to drive the sampler an additional 12" is known as the penetration resistance or N value. The N value is an index of the relative density of the cohesionless (sandy) soils and the consistency of cohesive (clayey) soils. Thin walled tube samples, if taken, were obtained according the ASTM: D1587 where indicated by the appropriate symbol on the boring logs. Rock core samples, if taken, were obtained by rotary drilling in accordance with ASTM: D2113. Power auger borings, if performed, were done in general accordance with ASTM: D1452.

Soil Classification

As the samples were obtained in the field, they were visually and manually classified by the crew chief in general accordance with ASTM: D2487. Representative portions of the samples were then returned to the laboratory for further examination and for verification of the field classification. Logs of the borings (test holes) indicating the depth and identification of the various strata, the N value, water level information and pertinent information regarding the method of maintaining and advancing the bore holes are attached. Charts illustrating the descriptive terminology and the symbols used on the boring logs are also attached.

LOG OF BORING– “DESCRIPTIONS”

Depth - Depth below the existing grade at the location and time the sampling was performed.

Description of Material – Soil type based on visual and manual methods and/or laboratory tests (see “Soil Classification” above).

Surface Elevation – Elevation of the existing grade at the boring location and at the time the boring was performed.

Geologic Origin - A description of the most likely source of the soil deposit.

WL - The highest groundwater measurement at the time and location the sampling was performed marked by the symbol ▼. (Also see “Water Level Measurements” on boring log).

N VALUE - The number of hammer blows required to drive the sampler 12" (see “Soil Sampling” above).

SAMPLE NO. – The sample number, i.e. 1, 2, 3....

SAMPLE TYPE – The type of equipment used to sample the soil (SPT = Standard Penetration Test, SB = Split Barrel Sampler, FA = Flight Auger, HSA = Hollow Stem Auger).

QU – Laboratory test. (See the attached “Symbols and Terminology.”)

Drilling Method – The type of equipment used in to advance (drill) the boring.

SYMBOLS AND TERMINOLOGY

DRILLING AND SAMPLING SYMBOLS

<u>SYMBOL</u>	<u>DEFINITION</u>
N	Standard Penetration – blows per foot
WOH	Weight of Hammer
B	Bag Sample
DM	Drilling Mud
FA	Flight Auger
HA	Hand Auger
HSA	Hollow Stem Auger
JW	Jetting Water
NSR	No Sample Recovered
_Q	BQ, NQ or PQ Wireline System
SB	Split Barrel Sampler
SPT	Standard Penetration Test
3TW	3" Thin Walled Tube Sample
CS	California Sampler
▼	Water Level Symbol

TEST SYMBOLS

<u>SYMBOL</u>	<u>DEFINITION</u>
W	Water Content by weight (ASTM:D2216)
D	Dry Density - pounds per cubic foot
LL	Liquid Limit (ASTM: D4318)
PL	Plastic Limit (ASTM: D438)
Qu	Unconfined Compressive Strength – pounds per square foot (ASTM: D2166)
Pq	Penetrometer Reading – tons/square ft.
Su	Undrained Shear Strength
R	Laboratory Resistivity
G	Specific Gravity – ASTM: D854
OC	Organic Content
K	Coefficient of Permeability
VS	Field Vane Shear (ASTM: D2573)
RQD	Rock Quality Designation - percent
CR	Core Recovery (percent)

WATER LEVELS

Water levels shown on the test hole (boring) logs are the water levels measured in the test holes at the time and under the conditions indicated. In sand soil, the indicated levels may be considered fairly reliable ground water levels. In clay soil, it may not be possible to determine the ground water level within the normal time required for the test hole, except where lenses or layers of more pervious waterbearing soil are present. Even then, an extended period of time may be necessary to reach equilibrium. Therefore, the water levels shown on the test hole logs for cohesive or mixed texture soils may not indicate the true level of the ground water table. Perched water refers to water above an impervious layer, thus impeded in reaching the water table. The available water level information is given at the bottom of the log sheet.

DESCRIPTIVE TERMINOLOGY

<u>RELATIVE DENSITY</u>	<u>“N” VALUE</u>	<u>CONSISTENCY</u>	<u>“N” VALUE</u>		
very loose	0-4	very soft	0-1	Lamination	Up to ½” thick stratum
loose	5-10	soft	2-4	Layer	½” to 6”
medium dense	11-24	firm	5-8	Lens	½” to 6” discontinuous stratum, pocket
dense	25-50	stiff	9-15	Varved	Alternating laminations of clay, silt and/or fine grained sand, or colors thereof
very dense	>50	very stiff	16-30	Dry	Powdery, no noticeable water
		hard	31-60	Moist	Below saturation
		very hard	>60	Wet	Saturated, above liquid limit
				Waterbearing	Pervious - soil is below water

“N” is the Standard Penetration, in blows per foot, of a 140 pound hammer falling 30 inches onto a 2 inch OD split barrel sampler.

RELATIVE GRAVEL PROPORTIONS

<u>TERM</u>	<u>RANGE</u>
A trace of gravel	Less than 4%
A little gravel	5 – 15%
With gravel	16 – 50%

RELATIVE SIZES

Boulder	Over 12”
Cobble	3” - 12”
Gravel - Coarse	¾” - 3”
Gravel – Fine	#4 - ¾”
Sand – Coarse	#4 - #10
Sand - Medium	#10 - #40
Sand - Fine	#40 - #200
Silt & Clay	-#200, Based on Plasticity

PRECAUTIONS FOR EXCAVATING AND REFILLING DURING COLD WEATHER

The winter season in this area presents specific problems for foundation construction. Soils which are allowed to freeze undergo a moisture volume expansion, resulting in a loss of density. These frost-expanded soils will consolidate upon thawing, causing settlement of any structure supported on them. To prevent this settlement, frost should not be allowed to penetrate into the soils below any proposed structure.

Ideally, winter excavation should be limited to areas small enough to be refilled to a grade higher than footing grade on the same day. Typically, these areas should be filled to floor grade. Trenching back down to unfrozen soils for foundation construction can then be performed just prior to footing placement. The excavated trenches should be protected from freezing by means of insulating or heating during foundation construction. Backfilling of the foundation trenches should be performed immediately after the below-grade foundation construction is finished. In addition, any interior footings, or footings designed without frost protection should be extended below frost depth, unless adequate precautions are taken to prevent frost intrusion until the building can be enclosed and heated.

In many cases, final grade cannot be attained in one day's time, even though small areas are worked. In the event final grade cannot be attained in one day's time, frost can be expected to develop overnight. The depth of frost penetration can be minimized by leaving a layer of loose soil on top of the compacted material overnight. However, any frost which forms in this loose layer, or snow which accumulates, should be completely removed from the fill area prior to compaction and additional soil placement. Frozen soils, or soils containing frozen material or snow should never be used as fill material.

After the structure has been enclosed, all floor slab areas should be subjected to ample periods of heating to allow thawing of the soil system. Alternatively, the frozen soils can be completely removed and be replaced with an engineered fill. The floor slab areas should be checked at random and representative locations for remnant areas of frost, and density tests should be performed to document fill compaction prior to slab placement.

Due to the potential problems associated with fill placement during cold weather, any filling operations should be monitored by a full-time, on-site soils technician. Full-time monitoring aids in detecting areas of frozen material, or potential problems with frozen material within the fill, so that appropriate measures can be taken. The choice of fill material is particularly important during cold weather, since clean granular fill materials can be placed and compacted more efficiently than silty or clayey soils. In addition, greater magnitudes of heaving can be expected with freezing of the more frost susceptible silts and clays.

If more specific frost information or cold weather data concerning other construction materials is required, please contact us.

CONSTRUCTION OBSERVATIONS AND TESTING

- **Geotechnical Engineer's Observation**

The recommendations made in this report have been made based on the subsurface conditions found in the borings. It is possible that there are soil and water conditions on-site that were not represented by those borings. Therefore, we recommend that the completed excavation and prepared subgrade be observed and tested by a Geotechnical Engineer prior to fill placement or construction of any foundation elements. These observations are necessary to judge if all unsuitable materials have been removed from within the planned construction area and that an appropriate degree of lateral oversize has been provided for in those areas where fill will be placed below the bottom of foundation grade.

- **Field Density Tests**

We recommend a representative number of field density tests be taken in the engineered fill to aid in judging its suitability. We suggest the following guidelines relative to the number and spacing of the density tests:

- Footing Trench Areas: At least one density test should be performed for each 1½ foot depth of engineered fill placed below the footings and for each 1½ foot depth of engineered fill placed above the footings. The lateral spacing between each 1½ foot test below the footings should not exceed 30 lineal feet. Also, the lateral spacing between each 1½ foot test above the footings should not exceed 30 lineal feet.*
- Floor Slab Areas: At least one density test should be performed for each 1½ foot of engineered fill depth. The density tests should be laterally spaced so that there is a minimum of one test performed for every 2000 square feet of engineered fill placed below the floor slab.*
- Exterior Backfill Areas: At least one density test should be performed for each 2 feet of engineered fill depth and at least one test for every 30 lineal feet of engineered fill placed.*
- Utility Trench Areas: At least one density test should be performed for each 2 feet of engineered fill depth and at least one test for every 50 lineal feet of engineered fill placed.*
- Large Open Areas Such As Small Dams or Athletic Fields: The number of density tests will depend on the size and purpose of the area being filled, and thus should be left to the discretion of a qualified engineer or his representative.*

*Additional tests should be taken in confined areas, such as building corners. The actual number of tests should be left to the discretion of a qualified engineer or his representative. All proposed engineered fill material should be submitted to the laboratory for tests to check compliance with our recommendations and project specifications.

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

More construction problems are caused by site subsurface conditions than any other factor. As troublesome as subsurface problems can be, their frequency and extent have been lessened considerably in recent years, due in large measure to programs and publications of ASFE/ The Association of Engineering Firms Practicing in the Geosciences:'

The following suggestions and observations are offered to help you reduce the geotechnical-related delays, cost-overruns and other costly headaches that can occur during a construction project.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

A geotechnical engineering report is based on a subsurface exploration plan designed to incorporate a unique set of project-specific factors. These typically include: the general nature of the structure involved, its size and configuration, the location of the structure on the site and its orientation; physical concomitants such as access roads, parking lots, and underground utilities, and the level of additional risk which the client assumed by virtue of limitations imposed upon the exploratory program. To help avoid costly problems, consult the geotechnical engineer to determine how any factors which change subsequent to the date of the report may affect its recommendations.

Unless your consulting geotechnical engineer indicates otherwise, *your geotechnical engineering report should not be used:*

- When the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one;
- when the size or configuration of the proposed structure is altered;
- when the location or orientation of the proposed structure is modified;
- when there is a change of ownership, or
- for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems which may develop if they are not consulted after factors considered in their report's development have changed.

MOST GEOTECHNICAL "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site exploration identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are extrapolated by geo-

technical engineers who then render an opinion about overall subsurface conditions, their likely reaction to proposed construction activity, and appropriate foundation design. Even under optimal circumstances actual conditions may differ from those inferred to exist, because no geotechnical engineer, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. *Nothing can be done to prevent the unanticipated, but steps can be taken to help minimize their impact.* For this reason, *most experienced owners retain their geotechnical consultants through the construction stage, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.*

SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions may be modified by constantly-changing natural forces. Because a geotechnical engineering report is based on conditions which existed at the time of subsurface exploration, *construction decisions should not be based on a geotechnical engineering report whose adequacy may have been affected by time.* Speak with the geotechnical consultant to learn if additional tests are advisable before construction starts.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or ground-water fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Geotechnical engineers' reports are prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Unless indicated otherwise, this report was prepared expressly for the client involved and expressly for purposes indicated by the client. Use by any other persons for any purpose, or by the client for a different purpose, may result in problems. *No individual other than the client should apply this report for its intended purpose without first conferring with the geotechnical engineer. No person should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer*

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical engineering report. To help avoid these problems, the geotechnical engineer should be retained to work with other appropriate design professionals to explain relevant geotechnical findings and to review the adequacy of their plans and specifications relative to geotechnical issues.

BORING LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT

Final boring logs are developed by geotechnical engineers based upon their interpretation of field logs (assembled by site personnel) and laboratory evaluation of field samples. Only final boring logs customarily are included in geotechnical engineering reports. *These logs should not under any circumstances be redrawn* for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimize the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the all-too-frequent result. To minimize the likelihood of boring log misinterpretation, *give contractors ready access to the complete geotechnical engineering report* prepared or authorized for their use. Those who do not provide such access may proceed un-

der the *mistaken* impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes which aggravate them to disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY

Because geotechnical engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against geotechnical consultants. To help prevent this problem, geotechnical engineers have developed model clauses for use in written transmittals. These are *not* exculpatory clauses designed to foist geotechnical engineers' liabilities onto someone else. Rather, they are definitive clauses which identify where geotechnical engineers' responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your geotechnical engineering report, and you are encouraged to read them closely. Your geotechnical engineer will be pleased to give full and frank answers to your questions.

OTHER STEPS YOU CAN TAKE TO REDUCE RISK

Your consulting geotechnical engineer will be pleased to discuss other techniques which can be employed to mitigate risk. In addition, ASFEE has developed a variety of materials which may be beneficial. Contact ASFEE for a complimentary copy of its publications directory

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Phase II Environmental Site Assessment

Ellendale Public School
321 1st Street North
Ellendale, ND

Prepared for

Ellendale Public School

Project B2500693
February 19, 2025

Braun Intertec Corporation

February 26, 2025

Project B2500693

Lana Norton
Ellendale Public School
321 1st Street North
Ellendale, ND 58436

Re: Phase II Environmental Site Assessment
Ellendale Public School
321 1st Street North
Ellendale, North Dakota

Dear Ms. Norton:

On behalf of Ellendale Public School, Braun Intertec Corporation conducted Phase II Environmental Site Assessment (ESA) of the above-referenced site (Site) in accordance with the authorized scope of services described in our proposal dated January 15, 2025. The Phase II ESA was prepared in association with the redevelopment of the Site. For a complete discussion of our assessment, please refer to the attached Phase II ESA report.

The objective of the Phase II ESA was to evaluate whether the soil or groundwater beneath the Site has been impacted due to the potential petroleum impacts that were identified in a previous geotechnical survey of the Site.

This Phase II ESA was prepared on behalf of and for use by Ellendale Public School. No other party has a right to rely on the contents of this Environmental Investigation without the written authorization of Braun Intertec.

We appreciate the opportunity to provide our professional services to you for this project. If you have any questions or comments regarding this report or the project in general, please contact Megan Klasen at 701.425.5347

Sincerely,

BRAUN INTERTEC CORPORATION


Megan M. Klasen
Project Scientist


Daniel P. Barrett
Principal Scientist

Attachment:
Phase II Environmental Site Assessment Report

Table of Contents

Description	Page
A. Introduction.....	1
A.1. Authorization.....	1
A.2. Project Objective.....	1
B. Site Background.....	1
B.1. Site Location and Description.....	1
B.2. Published Geologic Information.....	2
B.2.a. Topography.....	2
B.2.b. Geology.....	2
B.2.c. Hydrogeology.....	2
C. Scope of Services.....	2
C.1. Deviations from Work Plan/Proposal.....	3
D. Investigation Methods and Procedures.....	3
D.1. Soil Evaluation.....	4
D.1.a. Soil borings.....	4
D.1.b. Soil Classification and Monitoring.....	4
D.1.c. Soil Analyses.....	4
D.2. Groundwater Evaluation.....	5
D.2.a. Temporary Monitoring Wells.....	5
D.2.b. Temporary Monitoring Well Sampling.....	6
D.2.c. Groundwater Analyses.....	6
E. Investigation Results.....	6
E.1. Geologic Conditions.....	6
E.2. Hydrogeology.....	7
E.3. Field Screening.....	7
E.4. Soil Analytical Results.....	7
E.5. Groundwater Analytical Results.....	10
E.6. Quality Assurance/Quality Control.....	12
F. Conclusions.....	12
G. Recommendations.....	13
H. Assessment Limitations.....	13

Figures

- 1: Site Location Map
- 2: Site Diagram

Tables

- 1: Soil Analytical Results
- 2: Groundwater Analytical Results

Appendices

- A: Soil Boring Logs
- B: Laboratory Analytical Reports

A. Introduction

A.1. Authorization

Braun Intertec Corporation received authorization from Ms. Lana Norton at the Ellendale Public School to conduct a Phase II Environmental Site Assessment (ESA) of Ellendale Public School located at 321 1st Street North, in Ellendale, North Dakota (Site), in accordance with the scope of services described in Braun Intertec's proposal dated January 15, 2025.

This Phase II ESA was prepared on behalf of and for use by Ellendale Public School in accordance with the contract between Ellendale Public School and Braun Intertec. No other party has a right to rely on the contents of this Phase II ESA without the written authorization of Braun Intertec.

A.2. Project Objective

The objective of the Phase II ESA was to delineate the vertical and horizontal extent of the potential contamination identified in a former Geotechnical Report per the North Dakota Department of Environmental Quality (NDDEQ) requests.

B. Site Background

B.1. Site Location and Description

The Site is located at 321 1st Street North, Ellendale, North Dakota (see Figure 1). The Site is located within the SW quarter of the NW quarter of Section 12, Township 129 North, Range 63 West, in the city of Ellendale, Dickey County, North Dakota.

The Site consists of an approximate 5-acre developed parcel. The Site included an approximate 88,000-square foot, one-story, school. A former underground storage tank (UST) basin was located to the north-central portion of the Site, situated between two buildings. A Site Diagram is included as Figure 2.

B.2. Published Geologic Information

B.2.a. Topography

According to the United States Geological Survey (USGS) 7.5-minute topographic map series, Ellendale North, North Dakota quadrangle, the Site is located at an elevation of approximately 1,450 feet above mean sea level.

B.2.b. Geology

Dickey County, located in southeastern North Dakota on the southeastern edge of the Williston Basin, are underlain by 1,000 to 3,500 feet of Paleozoic and Mesozoic rocks that dip gently to the northwest (Bluemle, 1979). The Cretaceous Niobrara and Pierre Formations lie directly beneath the glacial drift and shale of the Pierre Formation is exposed in several places just east of the Missouri Escarpment (Bluemle, 1979). The Pleistocene Coleharbor Group, which covers most of the area, consists of glacial, fluvial, and lake sediment (Bluemle, 1979). The Coleharbor Group averages about 200 feet deep in the east; over 300 feet deep on the Missouri Coteau (Bluemle, 1979). It reaches a maximum thickness of over 500 feet in places on the Missouri Coteau (Bluemle, 1979).

B.2.c. Hydrogeology

According to published geologic information, the regional groundwater table in the vicinity of the Site occurs within the unconsolidated deposits at a depth of approximately 15 to 50 feet bgs and is expected to flow southeasterly towards the Dry Branch.

C. Scope of Services

The following tasks were conducted at the Site as part of this Environmental Investigation:

- Subcontracted a licensed drilling contractor to clear public utilities through North Dakota One Call and private utilities for the investigation locations.
- Subcontracted a licensed drilling contractor to complete soil borings, install temporary groundwater monitoring wells, and complete soil vapor probes.
- Advanced six environmental soil borings (SB-01 through SB-06) and collected soil samples.
- Installed two (2) temporary monitoring wells in the soil borings (MW-02 and MW-03) and collected groundwater samples.

- Conducted environmental monitoring during drilling and screened soil samples collected from the borings for the presence of organic vapors using a photoionization detector (PID). Visual and olfactory observations regarding potential contamination were also made and recorded.
- Analyzed representative samples of soil and groundwater for one or more of the following parameters: volatile organic compounds (VOCs), diesel range organics (DRO), and gasoline range organics (GRO).
- Evaluated the data and prepared this report.

C.1. Deviations from Work Plan/Proposal

Soil boring SB-05 was originally planned to be drilled north of 2nd Street North to delineate any petroleum impacts north of the Site. However, due to the lack of petroleum impacts in soil boring SB-04, soil boring SB-05 was moved north of SB-01 to further delineate the southern impact of the contamination.

Six (6) temporary monitoring wells were proposed to be installed in each of the soil borings. Due to the lack of groundwater, only two monitoring wells were installed in soil borings SB-02 and SB-03.

D. Investigation Methods and Procedures

The field work relating to the investigation was conducted on February 4, 2024. Prior to beginning the field investigation, public utilities were cleared through North Dakota One Call and private utilities were cleared through a subcontracted private utility locator.

Field methods and results are discussed in the following sections. Soil boring logs are provided in Appendix A, laboratory analytical report is provided in Appendix B.

- Six push probe soil borings (designated SB-01 through SB-06) were advanced at the Site. The soil borings were advanced as follows:
- Soil borings SB-01 through SB-04 were advanced to depths of 25-30 feet bgs at the Site near each Site boundary to delineate contamination.
- Soil borings SB-05 and SB-06 were advanced to a depth of 25 feet bgs to further delineate within the Site boundaries.

The soil borings are shown on Figure 2. The locations of the soil borings completed outside of the building were determined using GPS technology.

D.1. Soil Evaluation

D.1.a. Soil borings

Braun Intertec subcontracted Range Drilling, Hibbing, Minnesota, to advance six soil borings, designated as SB-01 through SB-06 at the Site to depths ranging from 25 to 30 feet bgs.

The soil borings were completed with a hydraulically-driven push-probe sampling rig. To collect the soil samples from the borings, a disposable thin-walled PVC liner was placed inside of a 5-foot long sampling tool. The borehole was then advanced using a dual-tube system, which allows for the inner sampling tool to be pushed through a larger outer-diameter rod a total penetration depth of up to 5 feet.

After advancing the tooling, the sampler was removed from the borehole, but the outer rod remained, keeping the borehole open, and the soil sample was retrieved from the PVC liner for field screening and classification. The process was then repeated to the termination depths of the borings.

Prior to arrival onsite, the drill rig and sampling equipment were cleaned with a high pressure, hot water sprayer. Between sampling locations, non-dedicated sampling equipment was cleaned with a soap and water scrub followed by a clean water rinse.

D.1.b. Soil Classification and Monitoring

Soils samples from the soil borings were visually and manually classified in the field by an environmental technician using ASTM D 2487 “Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)” and ASTM D 2488 “Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)”.

Soil samples retrieved were examined by an environmental technician, for unusual staining, odors, and other apparent signs of contamination. In addition, the soil samples were screened for the presence of organic vapors using a PID. The PID was equipped with a 10.6 -electron-volt lamp and calibrated to an isobutylene standard. The PID was used to perform direct measurement and a headspace method of field analyses.

D.1.c. Soil Analyses

Selected soil samples were collected from the soil borings for laboratory analysis as identified in the following table. Samples were submitted to Eurofins Laboratory in Cedar Falls, Iowa.

Soil Boring	Sampling Depth (feet bgs)	Rationale	Analytical Parameters
SB-01	7.5-10	Most likely area of highest contamination due to PID readings.	VOCs, GRO, DRO
SB-02	17.5-20	Most likely area of highest contamination due to PID readings.	VOCs, GRO, DRO
SB-03	7.5-10	Most likely area of highest contamination due to PID readings.	VOCs, GRO, DRO
SB-04	12.5-15	Most likely area of highest contamination due to PID readings.	VOCs, GRO, DRO
SB-05	10-12.5	Most likely area of highest contamination due to PID readings.	VOCs, GRO, DRO
SB-06	7.5-10	Most likely area of highest contamination due to PID readings.	VOCs, GRO, DRO

D.2. Groundwater Evaluation

Temporary monitoring wells (designated as MW-02 and MW-03) were installed in two of the soil borings to evaluate groundwater conditions at the Site. The temporary monitoring well locations are shown on Figure 2.

After the soil borings were advanced 10-feet into the water table, temporary monitoring wells were constructed using 1-inch diameter PVC riser and 5-foot long, 10-slot screens. Prior to sampling, static groundwater levels were measured in each monitoring well to the nearest 0.01 foot and recorded. The temporary monitoring wells were sampled using a check ball valve. Water samples retrieved were examined by the field technician for unusual odors, petroleum-like sheen, and other apparent signs of contamination. The groundwater samples were placed directly into laboratory supplied containers, preserved appropriately, and submitted to the laboratory for chemical analysis.

D.2.a. Temporary Monitoring Wells

After the soil borings were advanced 5-feet into the water table, temporary monitoring wells were constructed using 1-inch diameter PVC riser and one 5-foot long, 10-slot screens.

D.2.b. Temporary Monitoring Well Sampling

Prior to sampling, static groundwater levels in each monitoring well were measured to the nearest 0.01-foot and recorded. The monitoring wells were sampled shortly after installation for each well. Groundwater samples were collected using a check ball valve. Water samples retrieved were examined by the field technician for unusual odors, petroleum-like sheen, and other apparent signs of contamination. The groundwater samples were placed directly into laboratory supplied containers, preserved appropriately, and submitted to the laboratory for chemical analysis.

D.2.c. Groundwater Analyses

The groundwater samples collected from the temporary wells were submitted to Eurofins Laboratory in Cedar Falls, Iowa and analyzed for a combination of the following parameters:

- VOCs using EPA Method 8260
- TPH as DRO using the 8015 Method
- TPH as GRO using the 8015 Method

Analytical parameters for groundwater samples collected from each temporary well are summarized in Table 1.

E. Investigation Results

E.1. Geologic Conditions

Soil boring logs with descriptions of the various soil strata encountered during the soil boring operations and water level information are contained in Appendix A. The depths shown as changes between the soil types are approximate. The actual changes may be transitional, and the transition depths are likely to be horizontally variable.

Fill soils, consisting primarily of lean clay with gravel, were encountered from the ground surface to depths of 5 feet bgs. Underlying the fills soils was a layer consisting primarily of lean clay which varied in thickness from 5 to 30 feet bgs. Groundwater was encountered in boring SB-02 and SB-03 at depths of 14.26-feet bgs and 23.91-feet bgs, respectively.

E.2. Hydrogeology

Based on groundwater elevation data collected from monitoring wells MW-02 and MW-03, groundwater measurements showed depth to water ranging between 14.26-feet bgs and 23.91-feet bgs. Due to the lack of continuous groundwater throughout the Site, and vertical difference between the two measurements, it is likely that the water encountered in MW-02 and MW-03 is perched water.

E.3. Field Screening

Soil recovered from the soil borings was screened by the field technician for evidence of contamination, including odors, staining, and the presence of debris. No debris were observed in the soils recovered from any of the six borings. Black staining was recovered from all six soil borings near the surface. Petroleum like odors were observed in five (SB-01, SB-02, SB-03, SB-05, and SB-06) of the six soil borings below the fill at 5 feet below grade.

Organic vapor/PID readings were recorded for soil samples collected from each boring. Observed organic vapor concentrations ranged from 1.1 parts per million (ppm) to 589.1 ppm. Soil screening PID results are included on the boring logs in Appendix A.

Soil recovered from the soil borings was screened by the field technician for evidence of contamination, including odors, staining, and the presence of debris. Black staining was observed in all six soil borings within the upper 5 feet. Soil borings SB-01 through SB-03 had petroleum-like odors between 10 to 15 feet bgs. SB-02 had a PID reading of 589.1 ppm from the 17.5 to 20-foot interval. Soil screening PID results are included on the boring logs in Appendix A.

Groundwater samples were examined by the field technician for evidence of contamination, including unusual odors, petroleum-like sheen, and other apparent signs of contamination. A sheen was apparent in samples collected from MW-02 and odors were observed in both MW-02 and MW-03.

E.4. Soil Analytical Results

This section provides a discussion of soil analytical results. A summary of the soil analytical results is provided in Table 1. The complete laboratory reports with chain-of-custody forms are included in Appendix B.

The soil analytical results can be compared with the Risk Based Screening Levels (RBSLs) which are also listed on Table 1. These include Commercial/Industrial Surface Soil and Soil Protective of Groundwater RBSLs which are allowable risk-based contaminant concentrations derived by the NDDEQ using risk assessment methodology, modeling, and risk management policy to guide investigation and cleanup actions.

RBSLs relate to direct-contact exposure scenarios and potential leaching of contaminants to groundwater. Concentrations of contaminants in soil and RBSLs are expressed in units of milligrams per kilogram (mg/kg).

The following provides a summary of the soil analytical results.

- No VOCs, were detected at concentrations greater than or equal to the laboratory reporting limits for soil samples SB-04, and SB-05.
- The following VOCs were detected at concentrations greater than or equal to the laboratory reporting limits for soil sample SB-01.
 - Acetone had a detection of 0.175 mg/kg, which has no NDRBCA standards.
 - n-Butylbenzene had a detection of 0.0248 mg/kg, which has no NDRBCA standards.
 - sec-Butylbenzene had a detection of 0.0275 mg/kg, which has no NDRBCA standards.
 - 1,2,4-Trimethylbenzene had a detection of 0.0855 mg/kg, which is higher than the NDRBCA standard of 0.0808 mg/kg for protective of groundwater.
 - 1,3,5-Trimethylbenzene had a detection of 0.0281 mg/kg, which is less than the NDRBCA standard of 0.0866 mg/kg for protective of groundwater.
- The following VOCs were detected at concentrations greater than or equal to the laboratory reporting limits for soil sample SB-02.
 - n-Butylbenzene had a detection of 1.2 mg/kg, which has no NDRBCA standards.
 - sec-Butylbenzene had a detection of 0.555 mg/kg, which has no NDRBCA standards.
 - Isopropylbenzene (Cumene) had a detection of 0.154 mg/kg, which is less than the NDRBCA standard of 0.738 mg/kg for protective of groundwater.
 - p-Isopropyltoluene had a detection of 0.485 mg/kg, which has no NDRBCA standards.
 - Naphthalene had a detection of 2.37 mg/kg, which is higher than the NDRBCA standard of 0.00385 mg/kg for protective of groundwater.
 - n-Propylbenzene had a detection of 0.344 mg/kg, which has no NDRBCA standards.

- 1,2,4-Trimethylbenzene had a detection of 0.507 mg/kg, which is higher than the NDRBCA standard of 0.0808 mg/kg for protective of groundwater.
- 1,3,5-Trimethylbenzene had a detection of 0.728 mg/kg, which is higher than the NDRBCA standard of 0.0866 mg/kg for protective of groundwater.
- The following VOCs were detected at concentrations greater than or equal to the laboratory reporting limits for soil sample SB-03.
 - sec-Butylbenzene had a detection of 0.667 mg/kg, which has no NDRBCA standards.
 - Ethylbenzene had a detection of 0.0237 mg/kg, which is less than the NDRBCA standard of 0.785 mg/kg for protective of groundwater.
 - Isopropylbenzene (Cumene) had a detection of 0.0563 mg/kg, which is less than the NDRBCA standard of 0.738 mg/kg for protective of groundwater.
 - p-Isopropyltoluene had a detection of 0.089 mg/kg, which has no NDRBCA standards.
 - n-Propylbenzene had a detection of 0.101 mg/kg, which has no NDRBCA standards.
 - 1,2,4-Trimethylbenzene had a detection of 0.0747 mg/kg, which is less than the NDRBCA standard of 0.0808 mg/kg for protective of groundwater.
 - 1,3,5-Trimethylbenzene had a detection of 0.39 mg/kg, which is higher than the NDRBCA standard of 0.0866 mg/kg for protective of groundwater.
- The following VOCs were detected at concentrations greater than or equal to the laboratory reporting limits for soil sample SB-06.
 - n-Butylbenzene had a detection of 0.0671 mg/kg, which has no NDRBCA standards.
 - sec-Butylbenzene had a detection of 0.0205 mg/kg, which has no NDRBCA standards.
 - Ethylbenzene had a detection of 0.0221 mg/kg, which is less than the NDRBCA standard of 0.785 mg/kg for protective of groundwater.
 - Isopropylbenzene (Cumene) had a detection of 0.0177 mg/kg, which is less than the NDRBCA standard of 0.738 mg/kg for protective of groundwater.

- p-Isopropyltoluene had a detection of 0.0194 mg/kg, which has no NDRBCA standards.
- Naphthalene had a detection of 0.422 mg/kg, which is higher than the NDRBCA standard of 0.00385 mg/kg for protective of groundwater.
- n-Propylbenzene had a detection of 0.0464 mg/kg, which has no NDRBCA standards.
- 1,2,4-Trimethylbenzene had a detection of 0.037 mg/kg, which is less than the NDRBCA standard of 0.0808 mg/kg for protective of groundwater.
- 1,3,5-Trimethylbenzene had a detection of 0.106 mg/kg, which is higher than the NDRBCA standard of 0.0866 mg/kg for protective of groundwater.
- No DRO or GRO were detected at concentrations greater than or equal to the laboratory reporting limits for soil samples SB-01 or SB-04.
- DRO was detected in soil samples SB-02, SB-03, SB-05, and SB-06. Concentrations were 248 mg/kg, 4,120 mg/kg, 732 mg/kg, and 821 mg/kg, respectively. All four detections were higher than the NDRBCA standards for protective of groundwater of 100 mg/kg.
- GRO was detected in soil samples SB-02, SB-03, SB-05, and SB-06. Concentrations were 191 mg/kg, 382 mg/kg, 73.1 mg/kg, and 204 mg/kg, respectively. Soil samples SB-02, SB-03, and SB-06 had detections higher than the NDRBCA standards for protective of groundwater of 100 mg/kg, while soil sample SB-05 was less than the NDRBCA standards.

E.5. Groundwater Analytical Results

This section provides a discussion of the groundwater analytical results. Analytical results of the groundwater samples are provided in Table 2. For comparison purposes, Table 2 includes current Drinking Water Criteria (DWC) as well as the groundwater NDDEQ RBSL for Commercial/Industrial Domestic Groundwater. Concentrations of contaminants in water and Drinking Water Criteria are expressed in units of micrograms per liter ($\mu\text{g/L}$). The complete laboratory reports with chain-of-custody forms are included in Appendix B.

The following provides a summary of the groundwater analytical results.

- The following VOCs were detected in monitoring well MW-02:
 - Benzene had a concentration of 8.78 µg/L, which exceeds the NDRBCA standard for residential domestic groundwater use of 5.0 µg/L.
 - n-Butylbenzene had a concentration of 114.0 µg/L, which has no NDRBCA standard.
 - sec-Butylbenzene had a concentration of 38.0 µg/L, which has no NDRBCA standard.
 - Ethylbenzene had a concentration of 12.9 µg/L, which is less than the NDRBCA standard for residential domestic groundwater use of 700 µg/L..
 - Isopropylbenzene (Cumene) had a concentration of 27.1 µg/L, which is less than the NDRBCA standards for residential domestic groundwater use of 451 µg/L.
 - p-Isopropyltoluene had a concentration of 34.8 µg/L, which has no NDRBCA standard.
 - Naphthalene had a concentration of 998 µg/L, which is higher than the NDRBCA standard for residential domestic groundwater use of 1.17 µg/L.
 - n-Propylbenzene had a concentration of 46.7 µg/L, which has no NDRBCA standard.
 - 1,2,4-Trimethylbenzene had a concentration of 129 µg/L, which is higher than the NDRBCA standard for residential domestic groundwater use of 55.7 µg/L..
 - 1,3,5-Trimethylbenzene had a concentration of 229 µg/L, which is higher than the NDRBCA standard for residential domestic groundwater use of 60.3 µg/L.
- The following VOCs were detected in monitoring well MW-03:
 - n-Butylbenzene had a concentration of 9.39 µg/L, which has no NDRBCA standard.
 - n-Propylbenzene had a concentration of 7.54 µg/L, which has no NDRBCA standard.
 - 1,2,4-Trimethylbenzene had a concentration of 7.98 µg/L, which is less than the NDRBCA standard for residential domestic groundwater use of 55.7 µg/L..
 - 1,3,5-Trimethylbenzene had a concentration of 32.9 µg/L, which is less than the NDRBCA standard for residential domestic groundwater use of 60.3 µg/L..

- DRO was detected in both MW-02 and MW-03 at concentrations of 5,290,000 µg/L and 964 µg/L, both higher than the NDRBCA standards for residential domestic groundwater use of 500 µg/L.
- GRO was detected in MW-02 at a concentration of 8,100 µg/L, which is higher than the NDRBCA standards for residential domestic groundwater use of 500 µg/L.
- No GRO was detected at concentrations greater than or equal to the laboratory reporting limits for groundwater sample MW-03.

E.6. Quality Assurance/Quality Control

Samples were placed in clean, laboratory supplied containers, preserved, labeled, and transported to the Eurofins laboratory under refrigerated conditions using chain-of-custody procedures. Analyses were performed using EPA or other recognized standard procedures.

A quality assessment of field procedures and analytical laboratory reports was performed to evaluate potential effects on data quality used to support project objectives. All applicable Braun Intertec SOPs were followed as prescribed unless otherwise noted in this report. Notable findings are provided in more detail below and incorporated, where necessary, into this report.

A trip blank accompanied the investigative samples and was analyzed for VOCs. No contaminants were detected in the trip blank at concentrations greater than the laboratory method reporting limits. Data were reviewed prior to release, quality-control guidelines were generally met, and the data are considered usable.

F. Conclusions

Field screening and analytical data confirm petroleum impacts were detected at concentrations higher than the established NDDEQ criteria for both groundwater and soil. Based on the distribution and magnitude of the hydrocarbon impacts, it appears that the impacts are most likely associated with the former underground storage tank. Both the field screening and soil analytical data indicate that the petroleum impacts are confined to the Site, with the northern and the southern extent of the impacts being delineated in soil borings SB-01 and SB-04. Based on the results of the assessment, the impacts appeared to be contained to the central portion of the area extending west to east. However, due to the presence of the buildings located west and east of the impacted area, the impacts could not be further horizontally delineated in either direction.

While water was encountered during the investigation, due to the discontinuous nature of the water level within the four interbedded clay soil borings, no groundwater flow direction was identified. This likely indicates that the impacted water identified at the Site is perched groundwater pooling/accumulating along the buildings footing and the actual groundwater level is deeper than 30 feet below ground surface. This fill encountered at all boring locations is likely a result of fill material used to build up the area during construction of the Site.

G. Recommendations

Based on the results of this assessment, the soil borings advanced at the Site indicate that petroleum impacts associated with the former UST are present at the Site in between the western and eastern buildings. Based on the distribution of the borings, it appears that the impacts are delineated south and north and extend to approximately 20 feet bgs. While direct soil and groundwater exposure scenarios appear to have addressed, a potential vapor intrusion pathway remains on the western and eastern buildings. Due to the future redevelopment of the area and the unknown vapor exposure in the adjoining buildings, additional evaluation may be needed to assess the potential for contaminant vapors to migrate into and accumulate within the buildings located to the west and east of the Site.

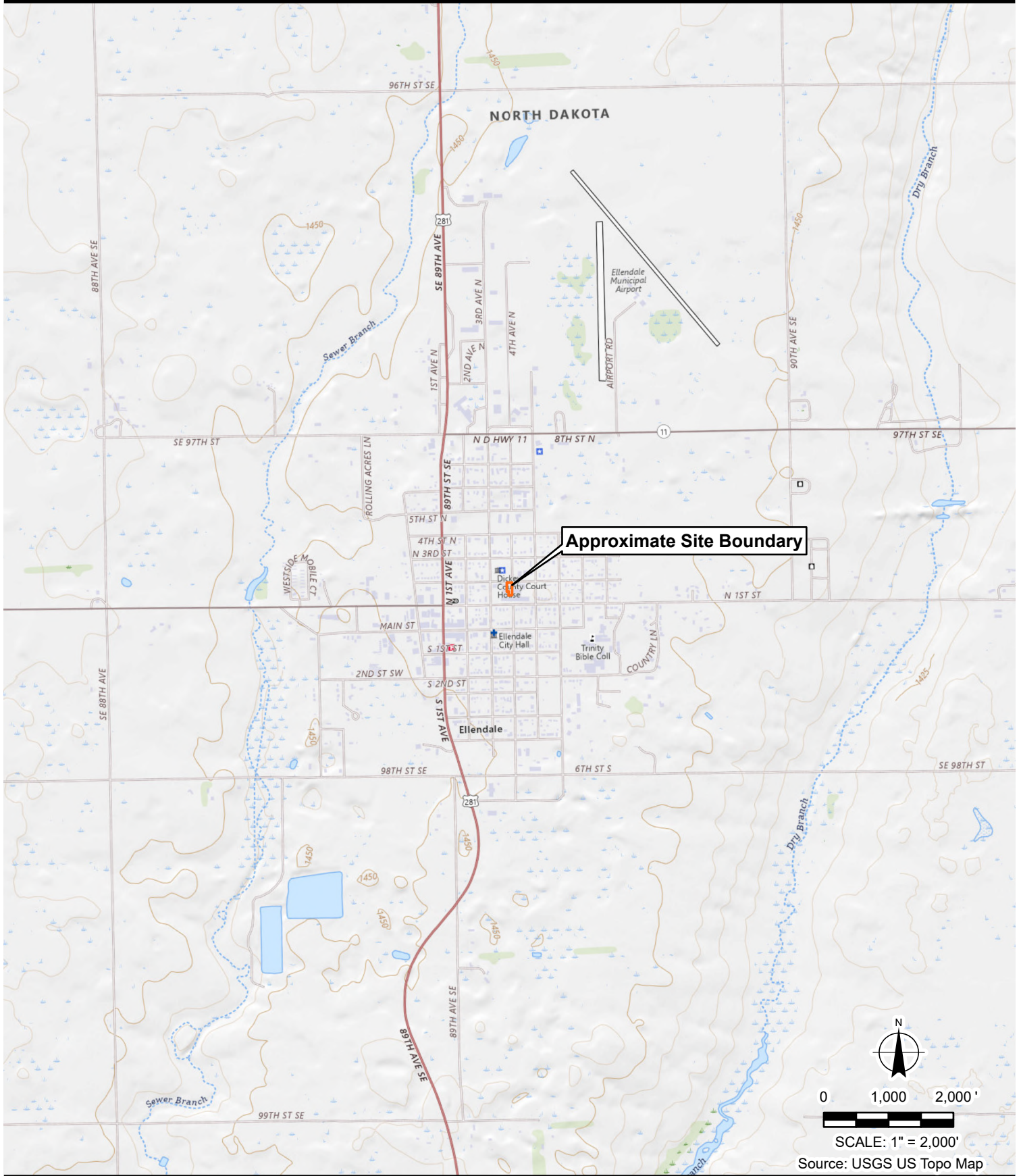
It is our opinion that this report and its enclosed documents be presented to the NDDEQ for their review. Once the NDDEQ staff have reviewed this report, we recommend opening a conversation to determine the most effective and cost-efficient method for remediating petroleum impacts associated with the impacts.

H. Assessment Limitations

The analyses and conclusions submitted in this report are based on field observations and the results of laboratory analyses of soil and groundwater samples, collected from the soil borings completed for this project.

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

Figures



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Bismarck, ND 58504
701.204.8875
braunintertec.com

Project No:
B2500693

Drawing No:
Fig1_SiteLocation

Drawn By: SL
Date Drawn: 2/6/2025
Checked By: JM
Last Modified: 2/6/2025

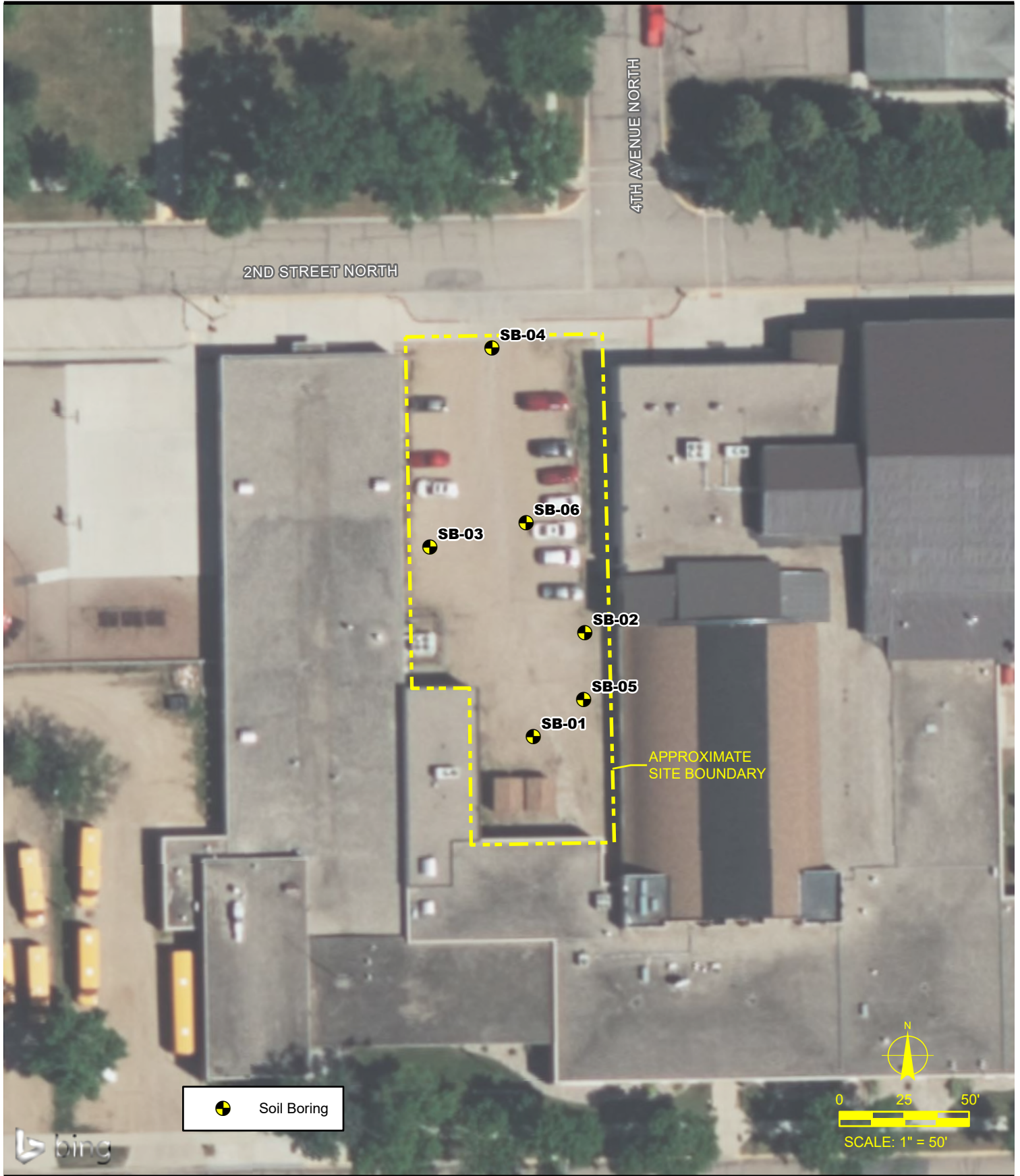
Ellendale Public School

321 1st Street North

Ellendale, North Dakota

Site Location Map

Figure 1



Tables

Table 1
Soil Analytical Results
Ellendale Public School
Ellendale, North Dakota
Project B2500693

Compound/Parameter	CAS No.	Sample Identifier and Date Collected						NDDEQ RBSLs ^[a]		
		SB-01 (10-12.5)	SB-02 (17.5-20)	SB-03 (7.5-10)	SB-04 (12.5-15)	SB-05 (10-12.5)	SB-06 (7.5-10)	Residential Surface Soil (mg/kg)	Protective of Groundwater (mg/kg)	Commercial/Industrial Surface Soil (mg/kg)
		02/04/2025	02/04/2025	02/04/2025	02/04/2025	02/04/2025	02/04/2025			
Volatile Organic Compounds (VOCs) (mg/kg)										
Acetone	67-64-1	0.175	<0.722	<0.132	<0.132	<0.135	<0.148	NE	NE	NE
n-Butylbenzene	104-51-8	0.0248	1.2	<0.0132	<0.0132	<0.0135	0.0671	NE	NE	NE
sec-Butylbenzene	135-98-8	0.0275	0.555	0.0667	<0.0132	<0.0135	0.0205	NE	NE	NE
Ethylbenzene	100-41-4	<0.0131	<0.144	0.0237	<0.0132	<0.0135	0.0221	57.8	0.785	254
Isopropylbenzene (Cumene)	98-82-8	<0.0131	0.154	0.0563	<0.0132	<0.0135	0.0177	1,950	0.738	9,950
p-Isopropyltoluene	99-87-6	<0.0131	0.485	0.089	<0.0132	<0.0135	0.0194	NE	NE	NE
Naphthalene	91-20-3	<0.0657	2.37	<0.0658	<0.0658	<0.0675	0.422	20.1	0.00385	85.7
n-Propylbenzene	103-65-1	<0.0131	0.344	0.101	<0.0132	<0.0135	0.0464	NE	NE	NE
1,2,4-Trimethylbenzene	95-63-6	0.0855	0.507	0.0747	<0.0132	<0.0135	0.037	303	0.0808	1770
1,3,5-Trimethylbenzene	108-67-8	0.0281	0.728	0.39	<0.0132	<0.0135	0.106	271	0.0866	1510
Petroleum Parameters (mg/kg)										
Diesel Range Organics (DRO)	---	<32.3	248	4,120	<35.3	732	821	NE	100 ^[b]	NE
Gasoline Range Organics (GRO)	---	<14.4	191	382	<14.1	73.1	204	NE	100 ^[b]	NE

Notes

^[a] = North Dakota Department of Environmental Quality (NDDEQ) has developed a Risk-Based Screening Levels (RBSLs) for the management of contaminant release sites. RBSLs are derived from a combination of Regional Screening Levels presented by United States Environmental Protection Agency and concentrations developed by NDDEQ. Residential land uses are defined where persons can be expected to reside for more than 8 hours a day, 7 days a week, such as homes, apartments, hospitals, nursing homes, residential schools, childcare centers, and similar facilities. Utilization of commercial/ industrial values are comprised from land uses where persons can be expected to be on Site less than 10 hours a day and absent on weekends and holidays. Surface soil is defined as less than 2 feet below ground surface. Values protective of groundwater are for soil at any depth below ground surface.

^[b] = NDDEQ has established a cleanup standard for total petroleum hydrocarbons (TPH), which is the sum total of all petroleum.

RBCA - Risk-Based Correction Action

mg/kg = Milligrams per kilogram.

< = Not detected at or above the laboratory reporting limit indicated.

--- = Not analyzed or calculated for this parameter or not applicable.

Bold indicates the compound was detected at or above the laboratory reporting limit.

Exceeds Residential RBSL
Exceeds Commercial/Industrial RBSL
Exceeds Protective of Groundwater RBSL

Table 2
Groundwater Analytical Results
Ellendale Public School
Ellendale, North Dakota
Project B2500693

Compound/Parameter	CAS No.	Sample Identifier, Depth to Groundwater, and Date Collected			NDDEQ Residential Domestic Groundwater Use RBSL ^[b] (ug/L)	NDDEQ Commercial /Industrial Domestic Groundwater RBSL ^[b] (ug/L)
		MW-02	MW-03	Trip Blank		
		14.26 feet	23.91 feet	N/A		
		02/04/2025	02/04/2025	02/04/2025		
Volatile Organic Compounds (VOCs)						
Benzene	71-43-2	8.78	<2.50	<0.500	5	5
n-Butylbenzene	104-51-8	114	9.39	<1.00	NE	NE
sec-Butylbenzene	135-98-8	38	<5.00	<1.00	NE	NE
Ethylbenzene	100-41-4	12.9	<5.00	<1.00	700	700
Isopropylbenzene (Cumene)	98-82-8	27.1	<5.00	<1.00	451	450
p-Isopropyltoluene	99-87-6	34.8	<5.00	<1.00	NE	NE
Naphthalene	91-20-3	998	<25.0	<5.00	1.17	1.2
n-Propylbenzene	103-65-1	46.7	7.54	<1.00	NE	NE
1,2,4-Trimethylbenzene	95-63-6	129	7.98	<1.00	55.7	56
1,3,5-Trimethylbenzene	108-67-8	229	32.9	<1.00	60.3	60
Other Parameters						
Diesel Range Organics (DRO)	---	5,290,000	964	---	500 ^[c]	500 ^[c]
Gasoline Range Organics (GRO)	---	8,100	<2,500	<500	500 ^[c]	500 ^[c]

Notes

^[b] = North Dakota Department of Environmental Quality (NDDEQ) has developed a Risk-Based Screening Levels (RBSLs) for the management of contaminant release sites and associated impacts to groundwater that is or potentially could be utilized for domestic use.

^[c] = NDDEQ has established a cleanup standard for total petroleum hydrocarbons (TPH), which is the sum total of all petroleum.

RBCA - Risk-Based Correction Action

NDDEQ = North Dakota Department of Environmental Quality

µg/L = Micrograms per liter

< = Not detected at or above the laboratory reporting limit indicated.

RL = Reporting limits for other parameters that are not listed individually in this table because their concentrations were below reporting limits provided in the laboratory report.

NE = Regulatory limit not established for this parameter.

Bold indicates the compound was detected at or above the laboratory reporting limit.

Exceeds Residential Domestic Use Criteria

Exceeds Commercial/Industrial Domestic Use Criteria

Appendix A

Environmental Boring Log - Not For Geotechnical Design

Project Number B2500693				BORING: SB-01	
Geotechnical Evaluation				LOCATION: Captured with RTK GPS.	
Ellendale Public School				DATUM: WGS 84	
321 1st Street North				LATITUDE: 46.003409	LONGITUDE: -98.523231
Ellendale, North Dakota				WEATHER: -3, cloudy	
DRILLER: Range Environmental	LOGGED BY: J.McCauley		<input checked="" type="checkbox"/> During Drilling <input type="checkbox"/> Not Encountered <input checked="" type="checkbox"/> After Drilling		
SURFACE ELEVATION: 1458.5 ft	RIG: Subcontractor	METHOD: Direct Push			
START DATE: 02/04/25	END DATE: 02/04/25	SURFACING: Gravel			

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Recovery %	PID ppm	Temp. Well	Tests or Remarks
1453.5 5.0	[Green Hatched Box]	LEAN CLAY with GRAVEL (CL), well graded, dark brown, moist, medium plasticity, black staining			1.2		SB-01 (7.5-10') @ 11:05 collected for chemical analysis
				100	1.1		
			5	2.9			
				100	3.1		
			10	13.2			
				100	5.4		
				100	2.1		
1433.5 25.0	[Green Hatched Box]	LEAN CLAY (CL), gray, moist, high plasticity, black staining			2.3		END OF BORING Boring then backfilled with auger cuttings
				100	2.0		
				100	1.9		
			25				
			30				

Environmental Boring Log - Not For Geotechnical Design

Project Number B2500693					BORING: SB-02		
Geotechnical Evaluation					LOCATION: Captured with RTK GPS.		
Ellendale Public School					DATUM: WGS 84		
321 1st Street North					LATITUDE: 46.003157	LONGITUDE: -98.523149	
Ellendale, North Dakota					WEATHER: -3, cloudy		
DRILLER: Range Environmental		LOGGED BY: J.McCauley			During Drilling 12.0 ft/Elev 1445.9 ft		
SURFACE ELEVATION: 1457.9 ft		RIG: Subcontractor		METHOD: Direct Push		After Drilling 14.3 ft/Elev 1443.6 ft	
START DATE: 02/04/25		END DATE: 02/04/25		SURFACING: Gravel			
Elev./Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Recovery %	PID ppm	Temp. Well	Tests or Remarks
1452.9 5.0		LEAN CLAY with GRAVEL (CL), well graded, dark brown, moist, medium plasticity, black staining		100	3.5 3.3		
1447.9 10.0		LEAN CLAY (CL), gray, moist, high plasticity, black staining	5	100	3.0 2.5		
1442.9 15.0	∇	LEAN CLAY (CL), gray, moist, high plasticity <i>Petroleum-like odor from 10 to 20 feet, with black staining from 15 to 20 feet</i>	10	100	81.2 141.4		MW-02 @ 12:00 collected for chemical analysis
1437.9 20.0	∇	LEAN CLAY (CL), gray, wet, high plasticity	15	100	562.7 589.1		SB-02 (17.5-20') @ 11:55 collected for chemical analysis
1427.9 30.0		LEAN CLAY (CL), gray, moist, high plasticity	20	100	50.7 20.2		
			25		9.8		
				40	4.7		
		END OF BORING	30				
		Boring then backfilled with auger cuttings					

Environmental Boring Log - Not For Geotechnical Design

Project Number B2500693				BORING: SB-03	
Geotechnical Evaluation				LOCATION: Captured with RTK GPS.	
Ellendale Public School				DATUM: WGS 84	
321 1st Street North				LATITUDE: 46.003252	LONGITUDE: -98.523381
Ellendale, North Dakota				WEATHER: -3, cloudy	
DRILLER: Range Environmental	LOGGED BY: J.McCauley				
SURFACE ELEVATION: 1457.3 ft	RIG: Subcontractor	METHOD: Direct Push	<input checked="" type="checkbox"/> During Drilling	22.0 ft/Elev 1435.3 ft	
START DATE: 02/04/25	END DATE: 02/04/25	SURFACING: Gravel	<input checked="" type="checkbox"/> After Drilling	23.9 ft/Elev 1433.4 ft	

Elev./Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Recovery %	PID ppm	Temp. Well	Tests or Remarks
1452.3 5.0		LEAN CLAY with GRAVEL (CL), well graded and poorly sorted, dark brown, moist, medium plasticity, black staining		100	1.3 1.5		
		LEAN CLAY (CL), gray, moist, high plasticity <i>Black staining and Petroleum-like odor from 5 to 12.5 feet</i>		100	189.7 211.1		SB-03 (7.5-10') @ 13:55 collected for chemical analysis
				100	128.6 49.0		
				100	3.5 3.2		
				100	3.1 2.6		MW-03 @ 14:00 collected for chemical analysis
1432.3 25.0		END OF BORING					
		Boring then backfilled with auger cuttings					



Environmental Boring Log - Not For Geotechnical Design

Project Number B2500693 Geotechnical Evaluation Ellendale Public School 321 1st Street North Ellendale, North Dakota				BORING: SB-04	
				LOCATION: Captured with RTK GPS.	
				DATUM: WGS 84	
				LATITUDE: 46.003461	LONGITUDE: -98.523279
DRILLER: Range Environmental	LOGGED BY: J.McCauley		WEATHER: -3, cloudy		
SURFACE ELEVATION: 1456.1 ft	RIG: Subcontractor	METHOD: Direct Push	<input checked="" type="checkbox"/> During Drilling <input type="checkbox"/> Not Encountered		
START DATE: 02/04/25	END DATE: 02/04/25	SURFACING: Gravel	<input checked="" type="checkbox"/> After Drilling		

Elev./Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Recovery %	PID ppm	Temp. Well	Tests or Remarks
1451.1 5.0		LEAN CLAY with GRAVEL (CL), well graded and poorly sorted, dark brown, moist, low plasticity, black staining	1	100	2.1		SB-04 (12.5-15') @ 14:50 collected for chemical analysis
			2	100	1.7		
		LEAN CLAY (CL), gray, moist, high plasticity	3	100	4.6		
			4	100	3.8		
			5	100	3.2		
			6	100	3.6		
			7	100	2.4		
8	100	2.1					
9	100	1.7					
10	100	2.1					
1431.1 25.0		END OF BORING	25				
		Boring then backfilled with auger cuttings					
			30				

Environmental Boring Log - Not For Geotechnical Design

Project Number B2500693				BORING: SB-05	
Geotechnical Evaluation				LOCATION: Captured with RTK GPS.	
Ellendale Public School				DATUM: WGS 84	
321 1st Street North				LATITUDE: 46.003087	LONGITUDE: -98.523279
Ellendale, North Dakota				WEATHER: -3, cloudy	
DRILLER: Range Environmental	LOGGED BY: J.McCauley		<input checked="" type="checkbox"/> During Drilling <input type="checkbox"/> Not Encountered <input checked="" type="checkbox"/> After Drilling		
SURFACE ELEVATION: 1457.9 ft	RIG: Subcontractor	METHOD: Direct Push			
START DATE: 02/04/25	END DATE: 02/04/25	SURFACING: Gravel			

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Recovery %	PID ppm	Temp. Well	Tests or Remarks
1452.9 5.0		LEAN CLAY with GRAVEL (CL), well graded and poorly sorted, dark brown, moist, low plasticity, black staining			2.1		SB-05 (10-12.5) @ 15:40 collected for chemical analysis
					100	2.4	
				5		13.6	
					100	11.8	
				10		119.8	
					100	82.6	
				15		40.2	
	100	32.3					
			20		17.4		
				100	9.8		
1432.9 25.0		END OF BORING	25				
		Boring then backfilled with auger cuttings					
			30				

Environmental Boring Log - Not For Geotechnical Design

Project Number B2500693				BORING: SB-06	
Geotechnical Evaluation				LOCATION: Captured with RTK GPS.	
Ellendale Public School				DATUM: WGS 84	
321 1st Street North				LATITUDE: 46.003275	LONGITUDE: -98.523234
Ellendale, North Dakota				WEATHER: -3, cloudy	
DRILLER: Range Environmental	LOGGED BY: J.McCauley		<input checked="" type="checkbox"/> During Drilling <input type="checkbox"/> Not Encountered		
SURFACE ELEVATION: 1457.0 ft	RIG: Subcontractor	METHOD: Direct Push	<input checked="" type="checkbox"/> After Drilling		
START DATE: 02/04/25	END DATE: 02/04/25	SURFACING: Gravel			

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487; Rock-USACE EM 1110-1-2908)	Sample	Recovery %	PID ppm	Temp. Well	Tests or Remarks
1452.0		LEAN CLAY with GRAVEL (CL), well graded and poorly sorted, dark brown, moist, low plasticity, black staining		100	4.2 6.4		
5.0		LEAN CLAY (CL), gray, moist, high plasticity	5	100	63.4		SB-06 (7.5-10') @ 16:20 collected for chemical analysis
			10	100	169.2		
			15	100	98.1		
			20	100	97.6		
			25	100	51.2		
1432.0		END OF BORING		100	47.2		
25.0		Boring then backfilled with auger cuttings		100	32.3		
				100	24.5		
			30				

Appendix B



ANALYTICAL REPORT

PREPARED FOR

Attn: Jenna McCauley
Braun Intertec Corporation
2908 Morrison Avenue
Suite #3
Bismark, North Dakota 58504

Generated 2/18/2025 1:07:53 PM

JOB DESCRIPTION

Ellendale School
B2500693

JOB NUMBER

310-300055-1

Eurofins Cedar Falls

Job Notes

This report may not be reproduced except in full, and with written approval from the laboratory. The results relate only to the samples tested. For questions please contact the Project Manager at the e-mail address or telephone number listed on this page.

The test results in this report relate only to the samples as received by the laboratory and will meet all requirements of the methodology, with any exceptions noted. This report shall not be reproduced except in full, without the express written approval of the laboratory. All questions should be directed to the Eurofins Environment Testing North Central, LLC Project Manager.

Authorization



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Authorized for release by
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Table of Contents

Cover Page	1
Table of Contents	3
Case Narrative	4
Sample Summary	6
Detection Summary	7
Client Sample Results	9
Definitions	27
Surrogate Summary	28
QC Sample Results	31
QC Association	49
Chronicle	53
Certification Summary	57
Method Summary	58
Chain of Custody	59
Receipt Checklists	61

Case Narrative

Client: Braun Intertec Corporation
Project: Ellendale School

Job ID: 310-300055-1

Job ID: 310-300055-1

Eurofins Cedar Falls

Job Narrative 310-300055-1

Analytical test results meet all requirements of the associated regulatory program listed on the Accreditation/Certification Summary Page unless otherwise noted under the individual analysis. Data qualifiers and/or narrative comments are included to explain any exceptions, if applicable.

- Matrix QC may not be reported if insufficient sample is provided or site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD may be performed, unless otherwise specified in the method.
- Surrogate and/or isotope dilution analyte recoveries (if applicable) which are outside of the QC window are confirmed unless attributed to a dilution or otherwise noted in the narrative.

Regulated compliance samples (e.g. SDWA, NPDES) must comply with the associated agency requirements/permits.

Receipt

The samples were received on 2/7/2025 9:00 AM. Unless otherwise noted below, the samples arrived in good condition, and, where required, properly preserved and on ice. The temperature of the cooler at receipt time was 3.9°C.

GC/MS VOA

Method 8260D: The following sample was collected in a properly preserved vial; however, the pH was outside the required criteria when verified by the laboratory. The samples were analyzed within the 7-day holding time specified for unpreserved samples: MW-02 (310-300055-7) and MW-03 (310-300055-8).

Method 8260D: The method requirement for no headspace was not met. The following volatile samples were analyzed with headspace in the sample container: MW-02 (310-300055-7) and MW-03 (310-300055-8).

Method 8260D: The following samples were diluted due to the nature of the sample matrix which included excessive sediment: MW-02 (310-300055-7) and MW-03 (310-300055-8). Elevated reporting limits (RLs) are provided.

Method 8260D: The continuing calibration verification (CCV) associated with batch 310-446646 recovered above the upper control limit for Bromoform (22.7%D). The LCS associated with this CCV passed CCV criteria for the affected analyte; therefore, the data have been reported. The associated sample is impacted: (CCV 310-446646/3).

Method 8260D: The continuing calibration verification (CCV) associated with batch 310-446785 recovered above the upper control limit for Carbon tetrachloride(22.8%D), Acetone(24.5%D), and 2,2-Dichloropropane(37.4%D). The samples associated with this CCV were non-detects for the affected analytes; therefore, the data have been reported. The associated sample is impacted: (CCV 310-446785/3).

Method 8260D: The continuing calibration verification (CCV) associated with batch 310-446785 recovered above the upper control limit for Chloroethane(23.6%D) and Trichlorofluoromethane(35.8%D). The samples associated with this CCV were non-detects for the affected analytes; therefore, the data have been reported. The associated sample is impacted: (CCV 310-446785/4).

Method 8260D: The continuing calibration verification (CCV) associated with batch 310-446663 recovered above the upper control limit for Dibromomethane(21.8%D) and 1,3-Dichloropropane(23.5%D). The samples associated with this CCV were non-detects for the affected analytes; therefore, the data have been reported. The associated sample is impacted: (CCV 310-446663/3).

Method 8260D: The continuing calibration verification (CCV) associated with batch 310-446665 recovered above the upper control limit for 1,3-Dichloropropane(23.3%D), 2-Butanone(52.1%D), and 1,2-Dichloropropane(26.5%D). The samples associated with this CCV were non-detects for the affected analytes; therefore, the data have been reported. The associated sample is impacted: (CCV 310-446665/3).

No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

Gasoline Range Organics

Method 8015C_GRO: The surrogate recovery for the LCS associated with analytical batch 310-446613 was outside the upper control limits.

Method 8015C_GRO: The method requirement for no headspace was not met. The following volatile samples were analyzed with headspace in the sample container(s): MW-02 (310-300055-7) and MW-03 (310-300055-8).

Eurofins Cedar Falls

Case Narrative

Client: Braun Intertec Corporation
Project: Ellendale School

Job ID: 310-300055-1

Job ID: 310-300055-1 (Continued)

Eurofins Cedar Falls

Method 8015C_GRO: The following samples were diluted due to excessive sediment in the samples: MW-02 (310-300055-7) and MW-03 (310-300055-8). Elevated reporting limits (RLs) are provided.

Method 8015C_GRO: The following sample(s) was collected in a properly preserved vial; however, the pH was outside the required criteria when verified by the laboratory. The samples were analyzed within the 7-day holding time specified for unpreserved samples: MW-02 (310-300055-7) and MW-03 (310-300055-8).

Method 8015C_GRO: The surrogate recovery for the LCS associated with preparation batch 310-446574 and analytical batch 310-446588 was outside the upper control limits.

Method 8015C_GRO: Surrogate recovery for the following samples were outside control limits: SB-03 (7.5-10) (310-300055-3), SB-05 (10-12.5) (310-300055-5) and SB-06 (7.5-10) (310-300055-6). Evidence of matrix interference is present; therefore, re-extraction and/or re-analysis was not performed.

Method 8015C_GRO: The surrogate recovery for the LCS associated with preparation batch 310-446819 and analytical batch 310-446823 was outside the upper control limits.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

Diesel Range Organics

Method 8015C_DRO: The following samples were provided to the laboratory with a significantly different initial weight than that required by the reference method: SB-01 (10-12.5) (310-300055-1), SB-03 (7.5-10) (310-300055-3), SB-04 (12.5-15) (310-300055-4), SB-05 (10-12.5) (310-300055-5) and SB-06 (7.5-10) (310-300055-6). The method requires 15g. The amount provided was below this range. less was used to prevent drying out

Method 8015C_DRO: The following sample was provided to the laboratory with a significantly different initial weight than that required by the reference method: SB-02 (17.5-20) (310-300055-2). The method requires 15g. The amount provided was below this range. Less was used to prevent drying out

No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

General Chemistry

No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

Eurofins Cedar Falls

Sample Summary

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
310-300055-1	SB-01 (10-12.5)	Solid	02/04/25 11:05	02/07/25 09:00
310-300055-2	SB-02 (17.5-20)	Solid	02/04/25 11:55	02/07/25 09:00
310-300055-3	SB-03 (7.5-10)	Solid	02/04/25 13:55	02/07/25 09:00
310-300055-4	SB-04 (12.5-15)	Solid	02/04/25 14:50	02/07/25 09:00
310-300055-5	SB-05 (10-12.5)	Solid	02/04/25 15:40	02/07/25 09:00
310-300055-6	SB-06 (7.5-10)	Solid	02/04/25 16:15	02/07/25 09:00
310-300055-7	MW-02	Water	02/04/25 12:00	02/07/25 09:00
310-300055-8	MW-03	Water	02/04/25 14:00	02/07/25 09:00
310-300055-9	HCL Blank	Water	02/04/25 00:00	02/07/25 09:00

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Detection Summary

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-01 (10-12.5)

Lab Sample ID: 310-300055-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Acetone	0.175		0.131		mg/Kg	1	✖	8260D	Total/NA
n-Butylbenzene	0.0248		0.0131		mg/Kg	1	✖	8260D	Total/NA
sec-Butylbenzene	0.0275		0.0131		mg/Kg	1	✖	8260D	Total/NA
1,2,4-Trimethylbenzene	0.0855		0.0131		mg/Kg	1	✖	8260D	Total/NA
1,3,5-Trimethylbenzene	0.0281		0.0131		mg/Kg	1	✖	8260D	Total/NA

Client Sample ID: SB-02 (17.5-20)

Lab Sample ID: 310-300055-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Isopropylbenzene	0.154		0.144		mg/Kg	1	✖	8260D	Total/NA
Naphthalene	2.37		0.361		mg/Kg	1	✖	8260D	Total/NA
n-Butylbenzene	1.20		0.144		mg/Kg	1	✖	8260D	Total/NA
n-Propylbenzene	0.344		0.144		mg/Kg	1	✖	8260D	Total/NA
p-Isopropyltoluene	0.485		0.144		mg/Kg	1	✖	8260D	Total/NA
sec-Butylbenzene	0.555		0.144		mg/Kg	1	✖	8260D	Total/NA
1,2,4-Trimethylbenzene	0.507		0.144		mg/Kg	1	✖	8260D	Total/NA
1,3,5-Trimethylbenzene	0.728		0.144		mg/Kg	1	✖	8260D	Total/NA
Gasoline Range Organics [C6-C12]	191		14.5		mg/Kg	1	✖	8015C	Total/NA
Diesel Range Organics [C10-C28]	248		12.4		mg/Kg	1	✖	8015C	Total/NA

Client Sample ID: SB-03 (7.5-10)

Lab Sample ID: 310-300055-3

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Ethylbenzene	0.0237		0.0132		mg/Kg	1	✖	8260D	Total/NA
Isopropylbenzene	0.0563		0.0132		mg/Kg	1	✖	8260D	Total/NA
n-Propylbenzene	0.101		0.0132		mg/Kg	1	✖	8260D	Total/NA
p-Isopropyltoluene	0.0890		0.0132		mg/Kg	1	✖	8260D	Total/NA
sec-Butylbenzene	0.0667		0.0132		mg/Kg	1	✖	8260D	Total/NA
1,2,4-Trimethylbenzene	0.0747		0.0132		mg/Kg	1	✖	8260D	Total/NA
1,3,5-Trimethylbenzene	0.390		0.0132		mg/Kg	1	✖	8260D	Total/NA
Gasoline Range Organics [C6-C12]	382		13.4		mg/Kg	1	✖	8015C	Total/NA
Diesel Range Organics [C10-C28]	4120		40.8		mg/Kg	1	✖	8015C	Total/NA

Client Sample ID: SB-04 (12.5-15)

Lab Sample ID: 310-300055-4

No Detections.

Client Sample ID: SB-05 (10-12.5)

Lab Sample ID: 310-300055-5

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Gasoline Range Organics [C6-C12]	73.1		14.3		mg/Kg	1	✖	8015C	Total/NA
Diesel Range Organics [C10-C28]	732		32.2		mg/Kg	1	✖	8015C	Total/NA

Client Sample ID: SB-06 (7.5-10)

Lab Sample ID: 310-300055-6

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Ethylbenzene	0.0221		0.0148		mg/Kg	1	✖	8260D	Total/NA
Isopropylbenzene	0.0177		0.0148		mg/Kg	1	✖	8260D	Total/NA
Naphthalene	0.422		0.0741		mg/Kg	1	✖	8260D	Total/NA
n-Butylbenzene	0.0671		0.0148		mg/Kg	1	✖	8260D	Total/NA
n-Propylbenzene	0.0464		0.0148		mg/Kg	1	✖	8260D	Total/NA
p-Isopropyltoluene	0.0194		0.0148		mg/Kg	1	✖	8260D	Total/NA
sec-Butylbenzene	0.0205		0.0148		mg/Kg	1	✖	8260D	Total/NA
1,2,4-Trimethylbenzene	0.0370		0.0148		mg/Kg	1	✖	8260D	Total/NA

This Detection Summary does not include radiochemical test results.

Eurofins Cedar Falls

Detection Summary

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-06 (7.5-10) (Continued)

Lab Sample ID: 310-300055-6

Analyte	Result	Qualifier	RL	MDL	Unit	Dil	Fac	D	Method	Prep Type
1,3,5-Trimethylbenzene	0.106		0.0148		mg/Kg	1		*	8260D	Total/NA
Gasoline Range Organics [C6-C12]	204		14.1		mg/Kg	1		*	8015C	Total/NA
Diesel Range Organics [C10-C28]	821		33.7		mg/Kg	1		*	8015C	Total/NA

Client Sample ID: MW-02

Lab Sample ID: 310-300055-7

Analyte	Result	Qualifier	RL	MDL	Unit	Dil	Fac	D	Method	Prep Type
Benzene	8.78		2.50		ug/L	5			8260D	Total/NA
Ethylbenzene	12.9		5.00		ug/L	5			8260D	Total/NA
Hexane	5.58		5.00		ug/L	5			8260D	Total/NA
Isopropylbenzene	27.1		5.00		ug/L	5			8260D	Total/NA
Naphthalene	998		25.0		ug/L	5			8260D	Total/NA
n-Butylbenzene	114		5.00		ug/L	5			8260D	Total/NA
n-Propylbenzene	46.7		5.00		ug/L	5			8260D	Total/NA
p-Isopropyltoluene	34.8		5.00		ug/L	5			8260D	Total/NA
sec-Butylbenzene	38.0		5.00		ug/L	5			8260D	Total/NA
1,2,4-Trimethylbenzene	129		5.00		ug/L	5			8260D	Total/NA
1,3,5-Trimethylbenzene	229		5.00		ug/L	5			8260D	Total/NA
Gasoline Range Organics [C6-C12]	8100		2500		ug/L	5			8015C	Total/NA
Diesel Range Organics [C10-C28]	5290000		25600		ug/L	50			8015C	Total/NA

Client Sample ID: MW-03

Lab Sample ID: 310-300055-8

Analyte	Result	Qualifier	RL	MDL	Unit	Dil	Fac	D	Method	Prep Type
n-Butylbenzene	9.39		5.00		ug/L	5			8260D	Total/NA
n-Propylbenzene	7.54		5.00		ug/L	5			8260D	Total/NA
1,2,4-Trimethylbenzene	7.98		5.00		ug/L	5			8260D	Total/NA
1,3,5-Trimethylbenzene	32.9		5.00		ug/L	5			8260D	Total/NA
Diesel Range Organics [C10-C28]	964		341		ug/L	1			8015C	Total/NA

Client Sample ID: HCL Blank

Lab Sample ID: 310-300055-9

No Detections.

This Detection Summary does not include radiochemical test results.

Eurofins Cedar Falls

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-01 (10-12.5)

Lab Sample ID: 310-300055-1

Date Collected: 02/04/25 11:05

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 80.1

Method: SW846 8260D - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	0.175		0.131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Benzene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Bromobenzene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Bromochloromethane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Bromodichloromethane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Bromoform	<0.0263		0.0263		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Bromomethane	<0.0526		0.0526		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
2-Butanone (MEK)	<0.0526		0.0526		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Carbon disulfide	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Carbon tetrachloride	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Chlorobenzene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Chlorodibromomethane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Chloroethane	<0.0526		0.0526		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Chloroform	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Chloromethane	<0.0526		0.0526		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
2-Chlorotoluene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
4-Chlorotoluene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
cis-1,2-Dichloroethene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
cis-1,3-Dichloropropene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,2-Dibromo-3-chloropropane	<0.0263		0.0263		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,2-Dibromoethane (EDB)	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Dibromomethane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,2-Dichlorobenzene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,3-Dichlorobenzene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,4-Dichlorobenzene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Dichlorodifluoromethane	<0.0394		0.0394		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,1-Dichloroethane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,2-Dichloroethane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,1-Dichloroethene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,2-Dichloropropane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,3-Dichloropropane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
2,2-Dichloropropane	<0.0526		0.0526		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,1-Dichloropropene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Ethylbenzene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Hexachlorobutadiene	<0.0657		0.0657		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Hexane	<0.0657		0.0657		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Isopropylbenzene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Methylene chloride	<0.131		0.131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Methyl tert-butyl ether	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Naphthalene	<0.0657		0.0657		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
n-Butylbenzene	0.0248		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
n-Propylbenzene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
p-Isopropyltoluene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
sec-Butylbenzene	0.0275		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Styrene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
tert-Butylbenzene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,1,1,2-Tetrachloroethane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,1,2,2-Tetrachloroethane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Tetrachloroethene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1

Eurofins Cedar Falls

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-01 (10-12.5)

Lab Sample ID: 310-300055-1

Date Collected: 02/04/25 11:05

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 80.1

Method: SW846 8260D - Volatile Organic Compounds by GC/MS (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Toluene	<0.0131		0.0131		mg/Kg	✳	02/11/25 09:03	02/11/25 15:44	1
trans-1,2-Dichloroethene	<0.0131		0.0131		mg/Kg	✳	02/11/25 09:03	02/11/25 15:44	1
trans-1,3-Dichloropropene	<0.0131		0.0131		mg/Kg	✳	02/11/25 09:03	02/11/25 15:44	1
1,2,3-Trichlorobenzene	<0.0263		0.0263		mg/Kg	✳	02/11/25 09:03	02/11/25 15:44	1
1,2,4-Trichlorobenzene	<0.0263		0.0263		mg/Kg	✳	02/11/25 09:03	02/11/25 15:44	1
1,1,1-Trichloroethane	<0.0131		0.0131		mg/Kg	✳	02/11/25 09:03	02/11/25 15:44	1
1,1,2-Trichloroethane	<0.0131		0.0131		mg/Kg	✳	02/11/25 09:03	02/11/25 15:44	1
Trichloroethene	<0.0131		0.0131		mg/Kg	✳	02/11/25 09:03	02/11/25 15:44	1
Trichlorofluoromethane	<0.0526		0.0526		mg/Kg	✳	02/11/25 09:03	02/11/25 15:44	1
1,2,3-Trichloropropane	<0.0131		0.0131		mg/Kg	✳	02/11/25 09:03	02/11/25 15:44	1
1,2,4-Trimethylbenzene	0.0855		0.0131		mg/Kg	✳	02/11/25 09:03	02/11/25 15:44	1
1,3,5-Trimethylbenzene	0.0281		0.0131		mg/Kg	✳	02/11/25 09:03	02/11/25 15:44	1
Vinyl chloride	<0.0263		0.0263		mg/Kg	✳	02/11/25 09:03	02/11/25 15:44	1
Xylenes, Total	<0.0263		0.0263		mg/Kg	✳	02/11/25 09:03	02/11/25 15:44	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	101		80 - 120				02/11/25 09:03	02/11/25 15:44	1
Dibromofluoromethane (Surr)	107		80 - 127				02/11/25 09:03	02/11/25 15:44	1
Toluene-d8 (Surr)	86		80 - 120				02/11/25 09:03	02/11/25 15:44	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Gasoline Range Organics [C6-C12]	<14.4		14.4		mg/Kg	✳	02/10/25 10:41	02/11/25 18:11	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	100		47 - 150				02/10/25 10:41	02/11/25 18:11	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	<32.3		32.3		mg/Kg	✳	02/12/25 10:18	02/14/25 03:04	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
n-Octacosane	42		12 - 150				02/12/25 10:18	02/14/25 03:04	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	19.9		0.1		%			02/08/25 11:49	1
Percent Solids (EPA Moisture)	80.1		0.1		%			02/08/25 11:49	1

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-02 (17.5-20)

Lab Sample ID: 310-300055-2

Date Collected: 02/04/25 11:55

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 80.5

Method: SW846 8260D - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<0.722		0.722		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Benzene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Bromobenzene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Bromochloromethane	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Bromodichloromethane	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Bromoform	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Bromomethane	<0.722		0.722		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
2-Butanone (MEK)	<1.08		1.08		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Carbon disulfide	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Carbon tetrachloride	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Chlorobenzene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Chlorodibromomethane	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Chloroethane	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Chloroform	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Chloromethane	<0.361		0.361		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
2-Chlorotoluene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
4-Chlorotoluene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
cis-1,2-Dichloroethene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
cis-1,3-Dichloropropene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
1,2-Dibromo-3-chloropropane	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
1,2-Dibromoethane (EDB)	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Dibromomethane	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
1,2-Dichlorobenzene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
1,3-Dichlorobenzene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
1,4-Dichlorobenzene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Dichlorodifluoromethane	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
1,1-Dichloroethane	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
1,2-Dichloroethane	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
1,1-Dichloroethene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
1,2-Dichloropropane	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
1,3-Dichloropropane	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
2,2-Dichloropropane	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
1,1-Dichloropropene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Ethylbenzene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Hexachlorobutadiene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Hexane	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Isopropylbenzene	0.154		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Methylene chloride	<0.361		0.361		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Methyl tert-butyl ether	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Naphthalene	2.37		0.361		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
n-Butylbenzene	1.20		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
n-Propylbenzene	0.344		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
p-Isopropyltoluene	0.485		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
sec-Butylbenzene	0.555		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Styrene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
tert-Butylbenzene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
1,1,1,2-Tetrachloroethane	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
1,1,2,2-Tetrachloroethane	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Tetrachloroethene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1

Eurofins Cedar Falls

Client Sample Results

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

Client Sample ID: SB-02 (17.5-20)

Lab Sample ID: 310-300055-2

Date Collected: 02/04/25 11:55

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 80.5

Method: SW846 8260D - Volatile Organic Compounds by GC/MS (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Toluene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
trans-1,2-Dichloroethene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
trans-1,3-Dichloropropene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
1,2,3-Trichlorobenzene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
1,2,4-Trichlorobenzene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
1,1,1-Trichloroethane	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
1,1,2-Trichloroethane	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Trichloroethene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Trichlorofluoromethane	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
1,2,3-Trichloropropane	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
1,2,4-Trimethylbenzene	0.507		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
1,3,5-Trimethylbenzene	0.728		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Vinyl chloride	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Xylenes, Total	<0.217		0.217		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	97		80 - 120				02/13/25 07:03	02/13/25 17:15	1
Dibromofluoromethane (Surr)	108		80 - 120				02/13/25 07:03	02/13/25 17:15	1
Toluene-d8 (Surr)	100		80 - 120				02/13/25 07:03	02/13/25 17:15	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Gasoline Range Organics [C6-C12]	191		14.5		mg/Kg	✳	02/10/25 10:41	02/11/25 18:37	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	122		47 - 150				02/10/25 10:41	02/11/25 18:37	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	248		12.4		mg/Kg	✳	02/17/25 10:28	02/18/25 11:04	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
n-Octacosane	74		12 - 150				02/17/25 10:28	02/18/25 11:04	1

General Chemistry

Analyte	Result	Qualifier	RL	RL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	19.5		0.1		%			02/08/25 11:49	1
Percent Solids (EPA Moisture)	80.5		0.1		%			02/08/25 11:49	1

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-03 (7.5-10)

Lab Sample ID: 310-300055-3

Date Collected: 02/04/25 13:55

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 82.3

Method: SW846 8260D - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<0.132		0.132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Benzene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Bromobenzene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Bromochloromethane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Bromodichloromethane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Bromoform	<0.0263		0.0263		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Bromomethane	<0.0526		0.0526		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
2-Butanone (MEK)	<0.0526		0.0526		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Carbon disulfide	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Carbon tetrachloride	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Chlorobenzene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Chlorodibromomethane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Chloroethane	<0.0526		0.0526		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Chloroform	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Chloromethane	<0.0526		0.0526		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
2-Chlorotoluene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
4-Chlorotoluene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
cis-1,2-Dichloroethene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
cis-1,3-Dichloropropene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
1,2-Dibromo-3-chloropropane	<0.0263		0.0263		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
1,2-Dibromoethane (EDB)	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Dibromomethane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
1,2-Dichlorobenzene	<0.00608		0.00608		mg/Kg	✳	02/17/25 07:27	02/18/25 08:11	1
1,3-Dichlorobenzene	<0.00608		0.00608		mg/Kg	✳	02/17/25 07:27	02/18/25 08:11	1
1,4-Dichlorobenzene	<0.00608		0.00608		mg/Kg	✳	02/17/25 07:27	02/18/25 08:11	1
Dichlorodifluoromethane	<0.0182		0.0182		mg/Kg	✳	02/17/25 07:27	02/18/25 08:11	1
1,1-Dichloroethane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
1,2-Dichloroethane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
1,1-Dichloroethene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
1,2-Dichloropropane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
1,3-Dichloropropane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
2,2-Dichloropropane	<0.0526		0.0526		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
1,1-Dichloropropene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Ethylbenzene	0.0237		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Hexachlorobutadiene	<0.0658		0.0658		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Hexane	<0.0658		0.0658		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Isopropylbenzene	0.0563		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Methylene chloride	<0.132		0.132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Methyl tert-butyl ether	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Naphthalene	<0.0658		0.0658		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
n-Butylbenzene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
n-Propylbenzene	0.101		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
p-Isopropyltoluene	0.0890		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
sec-Butylbenzene	0.0667		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Styrene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
tert-Butylbenzene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
1,1,1,2-Tetrachloroethane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
1,1,1,2,2-Tetrachloroethane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1
Tetrachloroethene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:08	02/12/25 02:34	1

Eurofins Cedar Falls

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-03 (7.5-10)

Lab Sample ID: 310-300055-3

Date Collected: 02/04/25 13:55

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 82.3

Method: SW846 8260D - Volatile Organic Compounds by GC/MS (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Toluene	<0.0132		0.0132		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
trans-1,2-Dichloroethene	<0.0132		0.0132		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
trans-1,3-Dichloropropene	<0.0132		0.0132		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
1,2,3-Trichlorobenzene	<0.0263		0.0263		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
1,2,4-Trichlorobenzene	<0.0263		0.0263		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
1,1,1-Trichloroethane	<0.0132		0.0132		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
1,1,2-Trichloroethane	<0.0132		0.0132		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
Trichloroethene	<0.0132		0.0132		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
Trichlorofluoromethane	<0.0526		0.0526		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
1,2,3-Trichloropropane	<0.0132		0.0132		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
1,2,4-Trimethylbenzene	0.0747		0.0132		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
1,3,5-Trimethylbenzene	0.390		0.0132		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
Vinyl chloride	<0.0263		0.0263		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
Xylenes, Total	<0.0263		0.0263		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	91		80 - 120	02/11/25 09:08	02/12/25 02:34	1
4-Bromofluorobenzene (Surr)	86		80 - 120	02/17/25 07:27	02/18/25 08:11	1
Dibromofluoromethane (Surr)	100		80 - 127	02/11/25 09:08	02/12/25 02:34	1
Dibromofluoromethane (Surr)	98		80 - 127	02/17/25 07:27	02/18/25 08:11	1
Toluene-d8 (Surr)	85		80 - 120	02/11/25 09:08	02/12/25 02:34	1
Toluene-d8 (Surr)	94		80 - 120	02/17/25 07:27	02/18/25 08:11	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Gasoline Range Organics [C6-C12]	382		13.4		mg/Kg	☼	02/10/25 10:41	02/11/25 19:03	1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	161	S1+	47 - 150	02/10/25 10:41	02/11/25 19:03	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	4120		40.8		mg/Kg	☼	02/12/25 10:18	02/14/25 03:19	1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
n-Octacosane	59		12 - 150	02/12/25 10:18	02/14/25 03:19	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	17.7		0.1		%			02/08/25 11:49	1
Percent Solids (EPA Moisture)	82.3		0.1		%			02/08/25 11:49	1

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-04 (12.5-15)

Lab Sample ID: 310-300055-4

Date Collected: 02/04/25 14:50

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 80.8

Method: SW846 8260D - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<0.132		0.132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Benzene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Bromobenzene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Bromochloromethane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Bromodichloromethane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Bromoform	<0.0263		0.0263		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Bromomethane	<0.0526		0.0526		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
2-Butanone (MEK)	<0.0526		0.0526		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Carbon disulfide	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Carbon tetrachloride	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Chlorobenzene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Chlorodibromomethane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Chloroethane	<0.0526		0.0526		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Chloroform	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Chloromethane	<0.0526		0.0526		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
2-Chlorotoluene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
4-Chlorotoluene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
cis-1,2-Dichloroethene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
cis-1,3-Dichloropropene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
1,2-Dibromo-3-chloropropane	<0.0263		0.0263		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
1,2-Dibromoethane (EDB)	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Dibromomethane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
1,2-Dichlorobenzene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
1,3-Dichlorobenzene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
1,4-Dichlorobenzene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Dichlorodifluoromethane	<0.0395		0.0395		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
1,1-Dichloroethane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
1,2-Dichloroethane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
1,1-Dichloroethene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
1,2-Dichloropropane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
1,3-Dichloropropane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
2,2-Dichloropropane	<0.0526		0.0526		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
1,1-Dichloropropene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Ethylbenzene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Hexachlorobutadiene	<0.0658		0.0658		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Hexane	<0.0658		0.0658		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Isopropylbenzene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Methylene chloride	<0.132		0.132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Methyl tert-butyl ether	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Naphthalene	<0.0658		0.0658		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
n-Butylbenzene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
n-Propylbenzene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
p-Isopropyltoluene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
sec-Butylbenzene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Styrene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
tert-Butylbenzene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
1,1,1,2-Tetrachloroethane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
1,1,2,2-Tetrachloroethane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Tetrachloroethene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1

Eurofins Cedar Falls

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-04 (12.5-15)

Lab Sample ID: 310-300055-4

Date Collected: 02/04/25 14:50

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 80.8

Method: SW846 8260D - Volatile Organic Compounds by GC/MS (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Toluene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
trans-1,2-Dichloroethene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
trans-1,3-Dichloropropene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
1,2,3-Trichlorobenzene	<0.0263		0.0263		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
1,2,4-Trichlorobenzene	<0.0263		0.0263		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
1,1,1-Trichloroethane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
1,1,2-Trichloroethane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Trichloroethene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Trichlorofluoromethane	<0.0526		0.0526		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
1,2,3-Trichloropropane	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
1,2,4-Trimethylbenzene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
1,3,5-Trimethylbenzene	<0.0132		0.0132		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Vinyl chloride	<0.0263		0.0263		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Xylenes, Total	<0.0263		0.0263		mg/Kg	✳	02/11/25 09:03	02/11/25 16:08	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	103		80 - 120				02/11/25 09:03	02/11/25 16:08	1
Dibromofluoromethane (Surr)	106		80 - 127				02/11/25 09:03	02/11/25 16:08	1
Toluene-d8 (Surr)	87		80 - 120				02/11/25 09:03	02/11/25 16:08	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Gasoline Range Organics [C6-C12]	<14.1		14.1		mg/Kg	✳	02/13/25 10:23	02/14/25 00:30	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	103		47 - 150				02/13/25 10:23	02/14/25 00:30	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	<35.3		35.3		mg/Kg	✳	02/12/25 10:18	02/14/25 03:33	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
n-Octacosane	57		12 - 150				02/12/25 10:18	02/14/25 03:33	1

General Chemistry

Analyte	Result	Qualifier	RL	RL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	19.2		0.1		%			02/08/25 11:49	1
Percent Solids (EPA Moisture)	80.8		0.1		%			02/08/25 11:49	1

Client Sample Results

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

Client Sample ID: SB-05 (10-12.5)

Lab Sample ID: 310-300055-5

Date Collected: 02/04/25 15:40

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 81.8

Method: SW846 8260D - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<0.135		0.135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Benzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Bromobenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Bromochloromethane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Bromodichloromethane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Bromoform	<0.0270		0.0270		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Bromomethane	<0.0540		0.0540		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
2-Butanone (MEK)	<0.0540		0.0540		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Carbon disulfide	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Carbon tetrachloride	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Chlorobenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Chlorodibromomethane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Chloroethane	<0.0540		0.0540		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Chloroform	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Chloromethane	<0.0540		0.0540		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
2-Chlorotoluene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
4-Chlorotoluene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
cis-1,2-Dichloroethene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
cis-1,3-Dichloropropene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,2-Dibromo-3-chloropropane	<0.0270		0.0270		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,2-Dibromoethane (EDB)	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Dibromomethane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,2-Dichlorobenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,3-Dichlorobenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,4-Dichlorobenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Dichlorodifluoromethane	<0.0405		0.0405		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,1-Dichloroethane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,2-Dichloroethane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,1-Dichloroethene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,2-Dichloropropane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,3-Dichloropropane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
2,2-Dichloropropane	<0.0540		0.0540		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,1-Dichloropropene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Ethylbenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Hexachlorobutadiene	<0.0675		0.0675		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Hexane	<0.0675		0.0675		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Isopropylbenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Methylene chloride	<0.135		0.135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Methyl tert-butyl ether	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Naphthalene	<0.0675		0.0675		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
n-Butylbenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
n-Propylbenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
p-Isopropyltoluene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
sec-Butylbenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Styrene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
tert-Butylbenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,1,1,2-Tetrachloroethane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,1,2,2-Tetrachloroethane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Tetrachloroethene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1

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Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-05 (10-12.5)

Lab Sample ID: 310-300055-5

Date Collected: 02/04/25 15:40

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 81.8

Method: SW846 8260D - Volatile Organic Compounds by GC/MS (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Toluene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
trans-1,2-Dichloroethene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
trans-1,3-Dichloropropene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,2,3-Trichlorobenzene	<0.0270		0.0270		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,2,4-Trichlorobenzene	<0.0270		0.0270		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,1,1-Trichloroethane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,1,2-Trichloroethane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Trichloroethene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Trichlorofluoromethane	<0.0540		0.0540		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,2,3-Trichloropropane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,2,4-Trimethylbenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,3,5-Trimethylbenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Vinyl chloride	<0.0270		0.0270		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Xylenes, Total	<0.0270		0.0270		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	106		80 - 120				02/11/25 09:03	02/11/25 16:32	1
Dibromofluoromethane (Surr)	103		80 - 127				02/11/25 09:03	02/11/25 16:32	1
Toluene-d8 (Surr)	87		80 - 120				02/11/25 09:03	02/11/25 16:32	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Gasoline Range Organics [C6-C12]	73.1		14.3		mg/Kg	✳	02/10/25 10:41	02/11/25 19:54	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	151	S1+	47 - 150				02/10/25 10:41	02/11/25 19:54	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	732		32.2		mg/Kg	✳	02/12/25 10:18	02/14/25 03:48	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
n-Octacosane	47		12 - 150				02/12/25 10:18	02/14/25 03:48	1

General Chemistry

Analyte	Result	Qualifier	RL	RL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	18.2		0.1		%			02/08/25 11:49	1
Percent Solids (EPA Moisture)	81.8		0.1		%			02/08/25 11:49	1

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-06 (7.5-10)

Lab Sample ID: 310-300055-6

Date Collected: 02/04/25 16:15

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 79.8

Method: SW846 8260D - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<0.148		0.148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Benzene	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Bromobenzene	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Bromochloromethane	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Bromodichloromethane	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Bromoform	<0.0296		0.0296		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Bromomethane	<0.0593		0.0593		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
2-Butanone (MEK)	<0.0593		0.0593		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Carbon disulfide	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Carbon tetrachloride	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Chlorobenzene	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Chlorodibromomethane	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Chloroethane	<0.0593		0.0593		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Chloroform	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Chloromethane	<0.0593		0.0593		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
2-Chlorotoluene	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
4-Chlorotoluene	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
cis-1,2-Dichloroethene	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
cis-1,3-Dichloropropene	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
1,2-Dibromo-3-chloropropane	<0.0296		0.0296		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
1,2-Dibromoethane (EDB)	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Dibromomethane	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
1,2-Dichlorobenzene	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
1,3-Dichlorobenzene	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
1,4-Dichlorobenzene	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Dichlorodifluoromethane	<0.0445		0.0445		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
1,1-Dichloroethane	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
1,2-Dichloroethane	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
1,1-Dichloroethene	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
1,2-Dichloropropane	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
1,3-Dichloropropane	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
2,2-Dichloropropane	<0.0593		0.0593		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
1,1-Dichloropropene	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Ethylbenzene	0.0221		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Hexachlorobutadiene	<0.0741		0.0741		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Hexane	<0.0741		0.0741		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Isopropylbenzene	0.0177		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Methylene chloride	<0.148		0.148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Methyl tert-butyl ether	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Naphthalene	0.422		0.0741		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
n-Butylbenzene	0.0671		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
n-Propylbenzene	0.0464		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
p-Isopropyltoluene	0.0194		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
sec-Butylbenzene	0.0205		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Styrene	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
tert-Butylbenzene	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
1,1,1,2-Tetrachloroethane	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
1,1,1,2,2-Tetrachloroethane	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Tetrachloroethene	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1

Eurofins Cedar Falls

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-06 (7.5-10)

Lab Sample ID: 310-300055-6

Date Collected: 02/04/25 16:15

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 79.8

Method: SW846 8260D - Volatile Organic Compounds by GC/MS (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Toluene	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
trans-1,2-Dichloroethene	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
trans-1,3-Dichloropropene	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
1,2,3-Trichlorobenzene	<0.0296		0.0296		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
1,2,4-Trichlorobenzene	<0.0296		0.0296		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
1,1,1-Trichloroethane	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
1,1,2-Trichloroethane	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Trichloroethene	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Trichlorofluoromethane	<0.0593		0.0593		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
1,2,3-Trichloropropane	<0.0148		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
1,2,4-Trimethylbenzene	0.0370		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
1,3,5-Trimethylbenzene	0.106		0.0148		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Vinyl chloride	<0.0296		0.0296		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Xylenes, Total	<0.0296		0.0296		mg/Kg	✳	02/11/25 09:03	02/11/25 16:56	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	106		80 - 120				02/11/25 09:03	02/11/25 16:56	1
Dibromofluoromethane (Surr)	100		80 - 127				02/11/25 09:03	02/11/25 16:56	1
Toluene-d8 (Surr)	86		80 - 120				02/11/25 09:03	02/11/25 16:56	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Gasoline Range Organics [C6-C12]	204		14.1		mg/Kg	✳	02/10/25 10:41	02/11/25 20:20	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	156	S1+	47 - 150				02/10/25 10:41	02/11/25 20:20	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	821		33.7		mg/Kg	✳	02/12/25 10:18	02/14/25 04:02	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
n-Octacosane	38		12 - 150				02/12/25 10:18	02/14/25 04:02	1

General Chemistry

Analyte	Result	Qualifier	RL	RL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	20.2		0.1		%			02/08/25 11:49	1
Percent Solids (EPA Moisture)	79.8		0.1		%			02/08/25 11:49	1

Client Sample Results

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

Client Sample ID: MW-02

Lab Sample ID: 310-300055-7

Date Collected: 02/04/25 12:00

Matrix: Water

Date Received: 02/07/25 09:00

Method: SW846 8260D - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<50.0		50.0		ug/L			02/11/25 16:42	5
Benzene	8.78		2.50		ug/L			02/11/25 16:42	5
Bromobenzene	<5.00		5.00		ug/L			02/11/25 16:42	5
Bromochloromethane	<25.0		25.0		ug/L			02/11/25 16:42	5
Bromodichloromethane	<5.00		5.00		ug/L			02/11/25 16:42	5
Bromoform	<25.0		25.0		ug/L			02/11/25 16:42	5
Bromomethane	<20.0		20.0		ug/L			02/11/25 16:42	5
2-Butanone (MEK)	<50.0		50.0		ug/L			02/11/25 16:42	5
Carbon disulfide	<5.00		5.00		ug/L			02/11/25 16:42	5
Carbon tetrachloride	<10.0		10.0		ug/L			02/11/25 16:42	5
Chlorobenzene	<5.00		5.00		ug/L			02/11/25 16:42	5
Chlorodibromomethane	<25.0		25.0		ug/L			02/11/25 16:42	5
Chloroethane	<20.0		20.0		ug/L			02/11/25 16:42	5
Chloroform	<15.0		15.0		ug/L			02/11/25 16:42	5
Chloromethane	<15.0		15.0		ug/L			02/11/25 16:42	5
2-Chlorotoluene	<5.00		5.00		ug/L			02/11/25 16:42	5
4-Chlorotoluene	<5.00		5.00		ug/L			02/11/25 16:42	5
cis-1,2-Dichloroethene	<5.00		5.00		ug/L			02/11/25 16:42	5
cis-1,3-Dichloropropene	<25.0		25.0		ug/L			02/11/25 16:42	5
1,2-Dibromo-3-chloropropane	<25.0		25.0		ug/L			02/11/25 16:42	5
1,2-Dibromoethane (EDB)	<5.00		5.00		ug/L			02/11/25 16:42	5
Dibromomethane	<5.00		5.00		ug/L			02/11/25 16:42	5
1,2-Dichlorobenzene	<5.00		5.00		ug/L			02/11/25 16:42	5
1,3-Dichlorobenzene	<5.00		5.00		ug/L			02/11/25 16:42	5
1,4-Dichlorobenzene	<5.00		5.00		ug/L			02/11/25 16:42	5
Dichlorodifluoromethane	<15.0		15.0		ug/L			02/11/25 16:42	5
1,1-Dichloroethane	<5.00		5.00		ug/L			02/11/25 16:42	5
1,2-Dichloroethane	<5.00		5.00		ug/L			02/11/25 16:42	5
1,1-Dichloroethene	<10.0		10.0		ug/L			02/11/25 16:42	5
1,2-Dichloropropane	<5.00		5.00		ug/L			02/11/25 16:42	5
1,3-Dichloropropane	<5.00		5.00		ug/L			02/11/25 16:42	5
2,2-Dichloropropane	<20.0		20.0		ug/L			02/11/25 16:42	5
1,1-Dichloropropene	<5.00		5.00		ug/L			02/11/25 16:42	5
Ethylbenzene	12.9		5.00		ug/L			02/11/25 16:42	5
Hexachlorobutadiene	<25.0		25.0		ug/L			02/11/25 16:42	5
Hexane	5.58		5.00		ug/L			02/11/25 16:42	5
Isopropylbenzene	27.1		5.00		ug/L			02/11/25 16:42	5
Methylene chloride	<25.0		25.0		ug/L			02/11/25 16:42	5
Methyl tert-butyl ether	<5.00		5.00		ug/L			02/11/25 16:42	5
Naphthalene	998		25.0		ug/L			02/11/25 16:42	5
n-Butylbenzene	114		5.00		ug/L			02/11/25 16:42	5
n-Propylbenzene	46.7		5.00		ug/L			02/11/25 16:42	5
p-Isopropyltoluene	34.8		5.00		ug/L			02/11/25 16:42	5
sec-Butylbenzene	38.0		5.00		ug/L			02/11/25 16:42	5
Styrene	<5.00		5.00		ug/L			02/11/25 16:42	5
tert-Butylbenzene	<5.00		5.00		ug/L			02/11/25 16:42	5
1,1,1,2-Tetrachloroethane	<5.00		5.00		ug/L			02/11/25 16:42	5
1,1,1,2,2-Tetrachloroethane	<5.00		5.00		ug/L			02/11/25 16:42	5
Tetrachloroethene	<5.00		5.00		ug/L			02/11/25 16:42	5

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: MW-02

Lab Sample ID: 310-300055-7

Date Collected: 02/04/25 12:00

Matrix: Water

Date Received: 02/07/25 09:00

Method: SW846 8260D - Volatile Organic Compounds by GC/MS (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Toluene	<5.00		5.00		ug/L			02/11/25 16:42	5
trans-1,2-Dichloroethene	<5.00		5.00		ug/L			02/11/25 16:42	5
trans-1,3-Dichloropropene	<25.0		25.0		ug/L			02/11/25 16:42	5
1,2,3-Trichlorobenzene	<25.0		25.0		ug/L			02/11/25 16:42	5
1,2,4-Trichlorobenzene	<25.0		25.0		ug/L			02/11/25 16:42	5
1,1,1-Trichloroethane	<5.00		5.00		ug/L			02/11/25 16:42	5
1,1,2-Trichloroethane	<5.00		5.00		ug/L			02/11/25 16:42	5
Trichloroethene	<5.00		5.00		ug/L			02/11/25 16:42	5
Trichlorofluoromethane	<20.0		20.0		ug/L			02/11/25 16:42	5
1,2,3-Trichloropropane	<5.00		5.00		ug/L			02/11/25 16:42	5
1,2,4-Trimethylbenzene	129		5.00		ug/L			02/11/25 16:42	5
1,3,5-Trimethylbenzene	229		5.00		ug/L			02/11/25 16:42	5
Vinyl chloride	<5.00		5.00		ug/L			02/11/25 16:42	5
Xylenes, Total	<15.0		15.0		ug/L			02/11/25 16:42	5

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	92		80 - 120		02/11/25 16:42	5
Dibromofluoromethane (Surr)	114		73 - 130		02/11/25 16:42	5
Toluene-d8 (Surr)	98		80 - 120		02/11/25 16:42	5

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Gasoline Range Organics [C6-C12]	8100		2500		ug/L			02/11/25 13:24	5

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	98		52 - 145		02/11/25 13:24	5

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	5290000		25600		ug/L		02/10/25 14:42	02/14/25 12:23	50

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
n-Octacosane	58		32 - 144	02/10/25 14:42	02/13/25 18:51	1

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: MW-03

Lab Sample ID: 310-300055-8

Date Collected: 02/04/25 14:00

Matrix: Water

Date Received: 02/07/25 09:00

Method: SW846 8260D - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<50.0		50.0		ug/L			02/11/25 17:04	5
Benzene	<2.50		2.50		ug/L			02/11/25 17:04	5
Bromobenzene	<5.00		5.00		ug/L			02/11/25 17:04	5
Bromochloromethane	<25.0		25.0		ug/L			02/11/25 17:04	5
Bromodichloromethane	<5.00		5.00		ug/L			02/11/25 17:04	5
Bromoform	<25.0		25.0		ug/L			02/11/25 17:04	5
Bromomethane	<20.0		20.0		ug/L			02/11/25 17:04	5
2-Butanone (MEK)	<50.0		50.0		ug/L			02/11/25 17:04	5
Carbon disulfide	<5.00		5.00		ug/L			02/11/25 17:04	5
Carbon tetrachloride	<10.0		10.0		ug/L			02/11/25 17:04	5
Chlorobenzene	<5.00		5.00		ug/L			02/11/25 17:04	5
Chlorodibromomethane	<25.0		25.0		ug/L			02/11/25 17:04	5
Chloroethane	<20.0		20.0		ug/L			02/11/25 17:04	5
Chloroform	<15.0		15.0		ug/L			02/11/25 17:04	5
Chloromethane	<15.0		15.0		ug/L			02/11/25 17:04	5
2-Chlorotoluene	<5.00		5.00		ug/L			02/11/25 17:04	5
4-Chlorotoluene	<5.00		5.00		ug/L			02/11/25 17:04	5
cis-1,2-Dichloroethene	<5.00		5.00		ug/L			02/11/25 17:04	5
cis-1,3-Dichloropropene	<25.0		25.0		ug/L			02/11/25 17:04	5
1,2-Dibromo-3-chloropropane	<25.0		25.0		ug/L			02/11/25 17:04	5
1,2-Dibromoethane (EDB)	<5.00		5.00		ug/L			02/11/25 17:04	5
Dibromomethane	<5.00		5.00		ug/L			02/11/25 17:04	5
1,2-Dichlorobenzene	<5.00		5.00		ug/L			02/11/25 17:04	5
1,3-Dichlorobenzene	<5.00		5.00		ug/L			02/11/25 17:04	5
1,4-Dichlorobenzene	<5.00		5.00		ug/L			02/11/25 17:04	5
Dichlorodifluoromethane	<15.0		15.0		ug/L			02/11/25 17:04	5
1,1-Dichloroethane	<5.00		5.00		ug/L			02/11/25 17:04	5
1,2-Dichloroethane	<5.00		5.00		ug/L			02/11/25 17:04	5
1,1-Dichloroethene	<10.0		10.0		ug/L			02/11/25 17:04	5
1,2-Dichloropropane	<5.00		5.00		ug/L			02/11/25 17:04	5
1,3-Dichloropropane	<5.00		5.00		ug/L			02/11/25 17:04	5
2,2-Dichloropropane	<20.0		20.0		ug/L			02/11/25 17:04	5
1,1-Dichloropropene	<5.00		5.00		ug/L			02/11/25 17:04	5
Ethylbenzene	<5.00		5.00		ug/L			02/11/25 17:04	5
Hexachlorobutadiene	<25.0		25.0		ug/L			02/11/25 17:04	5
Hexane	<5.00		5.00		ug/L			02/11/25 17:04	5
Isopropylbenzene	<5.00		5.00		ug/L			02/11/25 17:04	5
Methylene chloride	<25.0		25.0		ug/L			02/11/25 17:04	5
Methyl tert-butyl ether	<5.00		5.00		ug/L			02/11/25 17:04	5
Naphthalene	<25.0		25.0		ug/L			02/11/25 17:04	5
n-Butylbenzene	9.39		5.00		ug/L			02/11/25 17:04	5
n-Propylbenzene	7.54		5.00		ug/L			02/11/25 17:04	5
p-Isopropyltoluene	<5.00		5.00		ug/L			02/11/25 17:04	5
sec-Butylbenzene	<5.00		5.00		ug/L			02/11/25 17:04	5
Styrene	<5.00		5.00		ug/L			02/11/25 17:04	5
tert-Butylbenzene	<5.00		5.00		ug/L			02/11/25 17:04	5
1,1,1,2-Tetrachloroethane	<5.00		5.00		ug/L			02/11/25 17:04	5
1,1,2,2-Tetrachloroethane	<5.00		5.00		ug/L			02/11/25 17:04	5
Tetrachloroethene	<5.00		5.00		ug/L			02/11/25 17:04	5

Eurofins Cedar Falls

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: MW-03

Lab Sample ID: 310-300055-8

Date Collected: 02/04/25 14:00

Matrix: Water

Date Received: 02/07/25 09:00

Method: SW846 8260D - Volatile Organic Compounds by GC/MS (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Toluene	<5.00		5.00		ug/L			02/11/25 17:04	5
trans-1,2-Dichloroethene	<5.00		5.00		ug/L			02/11/25 17:04	5
trans-1,3-Dichloropropene	<25.0		25.0		ug/L			02/11/25 17:04	5
1,2,3-Trichlorobenzene	<25.0		25.0		ug/L			02/11/25 17:04	5
1,2,4-Trichlorobenzene	<25.0		25.0		ug/L			02/11/25 17:04	5
1,1,1-Trichloroethane	<5.00		5.00		ug/L			02/11/25 17:04	5
1,1,2-Trichloroethane	<5.00		5.00		ug/L			02/11/25 17:04	5
Trichloroethene	<5.00		5.00		ug/L			02/11/25 17:04	5
Trichlorofluoromethane	<20.0		20.0		ug/L			02/11/25 17:04	5
1,2,3-Trichloropropane	<5.00		5.00		ug/L			02/11/25 17:04	5
1,2,4-Trimethylbenzene	7.98		5.00		ug/L			02/11/25 17:04	5
1,3,5-Trimethylbenzene	32.9		5.00		ug/L			02/11/25 17:04	5
Vinyl chloride	<5.00		5.00		ug/L			02/11/25 17:04	5
Xylenes, Total	<15.0		15.0		ug/L			02/11/25 17:04	5
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	102		80 - 120					02/11/25 17:04	5
Dibromofluoromethane (Surr)	106		73 - 130					02/11/25 17:04	5
Toluene-d8 (Surr)	97		80 - 120					02/11/25 17:04	5

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Gasoline Range Organics [C6-C12]	<2500		2500		ug/L			02/11/25 13:53	5
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	98		52 - 145					02/11/25 13:53	5

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	964		341		ug/L		02/10/25 14:42	02/13/25 18:37	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
n-Octacosane	80		32 - 144				02/10/25 14:42	02/13/25 18:37	1

Client Sample Results

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

Client Sample ID: HCL Blank

Lab Sample ID: 310-300055-9

Date Collected: 02/04/25 00:00

Matrix: Water

Date Received: 02/07/25 09:00

Method: SW846 8260D - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<10.0		10.0		ug/L			02/11/25 11:27	1
Benzene	<0.500		0.500		ug/L			02/11/25 11:27	1
Bromobenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
Bromochloromethane	<5.00		5.00		ug/L			02/11/25 11:27	1
Bromodichloromethane	<1.00		1.00		ug/L			02/11/25 11:27	1
Bromoform	<5.00		5.00		ug/L			02/11/25 11:27	1
Bromomethane	<4.00		4.00		ug/L			02/11/25 11:27	1
2-Butanone (MEK)	<10.0		10.0		ug/L			02/11/25 11:27	1
Carbon disulfide	<1.00		1.00		ug/L			02/11/25 11:27	1
Carbon tetrachloride	<2.00		2.00		ug/L			02/11/25 11:27	1
Chlorobenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
Chlorodibromomethane	<5.00		5.00		ug/L			02/11/25 11:27	1
Chloroethane	<4.00		4.00		ug/L			02/11/25 11:27	1
Chloroform	<3.00		3.00		ug/L			02/11/25 11:27	1
Chloromethane	<3.00		3.00		ug/L			02/11/25 11:27	1
2-Chlorotoluene	<1.00		1.00		ug/L			02/11/25 11:27	1
4-Chlorotoluene	<1.00		1.00		ug/L			02/11/25 11:27	1
cis-1,2-Dichloroethene	<1.00		1.00		ug/L			02/11/25 11:27	1
cis-1,3-Dichloropropene	<5.00		5.00		ug/L			02/11/25 11:27	1
1,2-Dibromo-3-chloropropane	<5.00		5.00		ug/L			02/11/25 11:27	1
1,2-Dibromoethane (EDB)	<1.00		1.00		ug/L			02/11/25 11:27	1
Dibromomethane	<1.00		1.00		ug/L			02/11/25 11:27	1
1,2-Dichlorobenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
1,3-Dichlorobenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
1,4-Dichlorobenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
Dichlorodifluoromethane	<3.00		3.00		ug/L			02/11/25 11:27	1
1,1-Dichloroethane	<1.00		1.00		ug/L			02/11/25 11:27	1
1,2-Dichloroethane	<1.00		1.00		ug/L			02/11/25 11:27	1
1,1-Dichloroethene	<2.00		2.00		ug/L			02/11/25 11:27	1
1,2-Dichloropropane	<1.00		1.00		ug/L			02/11/25 11:27	1
1,3-Dichloropropane	<1.00		1.00		ug/L			02/11/25 11:27	1
2,2-Dichloropropane	<4.00		4.00		ug/L			02/11/25 11:27	1
1,1-Dichloropropene	<1.00		1.00		ug/L			02/11/25 11:27	1
Ethylbenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
Hexachlorobutadiene	<5.00		5.00		ug/L			02/11/25 11:27	1
Hexane	<1.00		1.00		ug/L			02/11/25 11:27	1
Isopropylbenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
Methylene chloride	<5.00		5.00		ug/L			02/11/25 11:27	1
Methyl tert-butyl ether	<1.00		1.00		ug/L			02/11/25 11:27	1
Naphthalene	<5.00		5.00		ug/L			02/11/25 11:27	1
n-Butylbenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
n-Propylbenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
p-Isopropyltoluene	<1.00		1.00		ug/L			02/11/25 11:27	1
sec-Butylbenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
Styrene	<1.00		1.00		ug/L			02/11/25 11:27	1
tert-Butylbenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
1,1,1,2-Tetrachloroethane	<1.00		1.00		ug/L			02/11/25 11:27	1
1,1,2,2-Tetrachloroethane	<1.00		1.00		ug/L			02/11/25 11:27	1
Tetrachloroethene	<1.00		1.00		ug/L			02/11/25 11:27	1

Eurofins Cedar Falls

Client Sample Results

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

Client Sample ID: HCL Blank

Lab Sample ID: 310-300055-9

Date Collected: 02/04/25 00:00

Matrix: Water

Date Received: 02/07/25 09:00

Method: SW846 8260D - Volatile Organic Compounds by GC/MS (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Toluene	<1.00		1.00		ug/L			02/11/25 11:27	1
trans-1,2-Dichloroethene	<1.00		1.00		ug/L			02/11/25 11:27	1
trans-1,3-Dichloropropene	<5.00		5.00		ug/L			02/11/25 11:27	1
1,2,3-Trichlorobenzene	<5.00		5.00		ug/L			02/11/25 11:27	1
1,2,4-Trichlorobenzene	<5.00		5.00		ug/L			02/11/25 11:27	1
1,1,1-Trichloroethane	<1.00		1.00		ug/L			02/11/25 11:27	1
1,1,2-Trichloroethane	<1.00		1.00		ug/L			02/11/25 11:27	1
Trichloroethene	<1.00		1.00		ug/L			02/11/25 11:27	1
Trichlorofluoromethane	<4.00		4.00		ug/L			02/11/25 11:27	1
1,2,3-Trichloropropane	<1.00		1.00		ug/L			02/11/25 11:27	1
1,2,4-Trimethylbenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
1,3,5-Trimethylbenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
Vinyl chloride	<1.00		1.00		ug/L			02/11/25 11:27	1
Xylenes, Total	<3.00		3.00		ug/L			02/11/25 11:27	1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	102		80 - 120		02/11/25 11:27	1
Dibromofluoromethane (Surr)	104		73 - 130		02/11/25 11:27	1
Toluene-d8 (Surr)	95		80 - 120		02/11/25 11:27	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Gasoline Range Organics [C6-C12]	<500		500		ug/L			02/11/25 05:12	1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	102		52 - 145		02/11/25 05:12	1

Definitions/Glossary

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Qualifiers

GC/MS VOA

Qualifier	Qualifier Description
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

GC VOA

Qualifier	Qualifier Description
S1+	Surrogate recovery exceeds control limits, high biased.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
☼	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

Surrogate Summary

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS

Matrix: Solid

Prep Type: Total/NA

Lab Sample ID	Client Sample ID	Percent Surrogate Recovery (Acceptance Limits)		
		BFB (80-120)	DBFM (80-120)	TOL (80-120)
310-300055-1	SB-01 (10-12.5)	101	107	86
310-300055-3	SB-03 (7.5-10)	91	100	85
310-300055-3	SB-03 (7.5-10)	86	98	94
310-300055-4	SB-04 (12.5-15)	103	106	87
310-300055-5	SB-05 (10-12.5)	106	103	87
310-300055-6	SB-06 (7.5-10)	106	100	86
LCS 310-446661/2-A	Lab Control Sample	105	101	91
LCS 310-446664/2-A	Lab Control Sample	109	102	93
LCS 310-446943/2-A	Lab Control Sample	101	98	101
MB 310-446661/1-A	Method Blank	98	106	86
MB 310-446664/1-A	Method Blank	106	102	90
MB 310-446943/1-A	Method Blank	93	102	97

Surrogate Legend

BFB = 4-Bromofluorobenzene (Surr)
DBFM = Dibromofluoromethane (Surr)
TOL = Toluene-d8 (Surr)

Method: 8260D - Volatile Organic Compounds by GC/MS

Matrix: Solid

Prep Type: Total/NA

Lab Sample ID	Client Sample ID	Percent Surrogate Recovery (Acceptance Limits)		
		BFB (80-120)	DBFM (80-120)	TOL (80-120)
310-300055-2	SB-02 (17.5-20)	97	108	100
LCS 310-446784/2-A	Lab Control Sample	104	102	96
MB 310-446784/1-A	Method Blank	104	108	102

Surrogate Legend

BFB = 4-Bromofluorobenzene (Surr)
DBFM = Dibromofluoromethane (Surr)
TOL = Toluene-d8 (Surr)

Method: 8260D - Volatile Organic Compounds by GC/MS

Matrix: Water

Prep Type: Total/NA

Lab Sample ID	Client Sample ID	Percent Surrogate Recovery (Acceptance Limits)		
		BFB (80-120)	DBFM (73-130)	TOL (80-120)
310-300055-7	MW-02	92	114	98
310-300055-8	MW-03	102	106	97
310-300055-9	HCL Blank	102	104	95
LCS 310-446646/6	Lab Control Sample	100	95	101
LCS 310-446646/7	Lab Control Sample	107	106	94
MB 310-446646/5	Method Blank	108	102	95

Surrogate Legend

BFB = 4-Bromofluorobenzene (Surr)
DBFM = Dibromofluoromethane (Surr)
TOL = Toluene-d8 (Surr)

Eurofins Cedar Falls

Surrogate Summary

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

Method: 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Matrix: Solid

Prep Type: Total/NA

Percent Surrogate Recovery (Acceptance Limits)

Lab Sample ID	Client Sample ID	BFB1 (47-150)
310-300055-1	SB-01 (10-12.5)	100
310-300055-2	SB-02 (17.5-20)	122
310-300055-3	SB-03 (7.5-10)	161 S1+
310-300055-4	SB-04 (12.5-15)	103
310-300055-5	SB-05 (10-12.5)	151 S1+
310-300055-6	SB-06 (7.5-10)	156 S1+
LCS 310-446574/2-A	Lab Control Sample	278 S1+
LCS 310-446819/2-A	Lab Control Sample	271 S1+
MB 310-446574/1-A	Method Blank	99
MB 310-446819/1-A	Method Blank	105

Surrogate Legend

BFB = 4-Bromofluorobenzene (Surr)

Method: 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Matrix: Water

Prep Type: Total/NA

Percent Surrogate Recovery (Acceptance Limits)

Lab Sample ID	Client Sample ID	BFB1 (52-145)
310-300055-7	MW-02	98
310-300055-8	MW-03	98
310-300055-9	HCL Blank	102
LCS 310-446613/4	Lab Control Sample	166 S1+
MB 310-446613/5	Method Blank	105

Surrogate Legend

BFB = 4-Bromofluorobenzene (Surr)

Method: 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Matrix: Solid

Prep Type: Total/NA

Percent Surrogate Recovery (Acceptance Limits)

Lab Sample ID	Client Sample ID	OTCN1 (12-150)
310-300055-1	SB-01 (10-12.5)	42
310-300055-2	SB-02 (17.5-20)	74
310-300055-3	SB-03 (7.5-10)	59
310-300055-4	SB-04 (12.5-15)	57
310-300055-5	SB-05 (10-12.5)	47
310-300055-6	SB-06 (7.5-10)	38
LCS 310-446752/2-A	Lab Control Sample	107
LCS 310-446980/2-A	Lab Control Sample	89
MB 310-446752/1-A	Method Blank	101
MB 310-446980/1-A	Method Blank	91

Surrogate Legend

OTCN = n-Octacosane

Surrogate Summary

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Matrix: Water

Prep Type: Total/NA

Percent Surrogate Recovery (Acceptance Limits)

Lab Sample ID	Client Sample ID	OTCN1 (32-144)
310-300055-7	MW-02	58
310-300055-8	MW-03	80
LCS 310-446619/2-A	Lab Control Sample	80
LCSD 310-446619/3-A	Lab Control Sample Dup	68
MB 310-446619/1-A	Method Blank	112

Surrogate Legend

OTCN = n-Octacosane

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- 11
- 12
- 13
- 14
- 15

QC Sample Results

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS

Lab Sample ID: MB 310-446646/5
Matrix: Water
Analysis Batch: 446646

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB	MB	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
Acetone	<10.0		10.0		ug/L			02/11/25 09:33	1
Benzene	<0.500		0.500		ug/L			02/11/25 09:33	1
Bromobenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
Bromochloromethane	<5.00		5.00		ug/L			02/11/25 09:33	1
Bromodichloromethane	<1.00		1.00		ug/L			02/11/25 09:33	1
Bromoform	<5.00		5.00		ug/L			02/11/25 09:33	1
Bromomethane	<4.00		4.00		ug/L			02/11/25 09:33	1
2-Butanone (MEK)	<10.0		10.0		ug/L			02/11/25 09:33	1
Carbon disulfide	<1.00		1.00		ug/L			02/11/25 09:33	1
Carbon tetrachloride	<2.00		2.00		ug/L			02/11/25 09:33	1
Chlorobenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
Chlorodibromomethane	<5.00		5.00		ug/L			02/11/25 09:33	1
Chloroethane	<4.00		4.00		ug/L			02/11/25 09:33	1
Chloroform	<3.00		3.00		ug/L			02/11/25 09:33	1
Chloromethane	<3.00		3.00		ug/L			02/11/25 09:33	1
2-Chlorotoluene	<1.00		1.00		ug/L			02/11/25 09:33	1
4-Chlorotoluene	<1.00		1.00		ug/L			02/11/25 09:33	1
cis-1,2-Dichloroethene	<1.00		1.00		ug/L			02/11/25 09:33	1
cis-1,3-Dichloropropene	<5.00		5.00		ug/L			02/11/25 09:33	1
1,2-Dibromo-3-chloropropane	<5.00		5.00		ug/L			02/11/25 09:33	1
1,2-Dibromoethane (EDB)	<1.00		1.00		ug/L			02/11/25 09:33	1
Dibromomethane	<1.00		1.00		ug/L			02/11/25 09:33	1
1,2-Dichlorobenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
1,3-Dichlorobenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
1,4-Dichlorobenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
Dichlorodifluoromethane	<3.00		3.00		ug/L			02/11/25 09:33	1
1,1-Dichloroethane	<1.00		1.00		ug/L			02/11/25 09:33	1
1,2-Dichloroethane	<1.00		1.00		ug/L			02/11/25 09:33	1
1,1-Dichloroethene	<2.00		2.00		ug/L			02/11/25 09:33	1
1,2-Dichloropropane	<1.00		1.00		ug/L			02/11/25 09:33	1
1,3-Dichloropropane	<1.00		1.00		ug/L			02/11/25 09:33	1
2,2-Dichloropropane	<4.00		4.00		ug/L			02/11/25 09:33	1
1,1-Dichloropropene	<1.00		1.00		ug/L			02/11/25 09:33	1
Ethylbenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
Hexachlorobutadiene	<5.00		5.00		ug/L			02/11/25 09:33	1
Hexane	<1.00		1.00		ug/L			02/11/25 09:33	1
Isopropylbenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
Methylene chloride	<5.00		5.00		ug/L			02/11/25 09:33	1
Methyl tert-butyl ether	<1.00		1.00		ug/L			02/11/25 09:33	1
Naphthalene	<5.00		5.00		ug/L			02/11/25 09:33	1
n-Butylbenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
n-Propylbenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
p-Isopropyltoluene	<1.00		1.00		ug/L			02/11/25 09:33	1
sec-Butylbenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
Styrene	<1.00		1.00		ug/L			02/11/25 09:33	1
tert-Butylbenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
1,1,1,2-Tetrachloroethane	<1.00		1.00		ug/L			02/11/25 09:33	1
1,1,2,2-Tetrachloroethane	<1.00		1.00		ug/L			02/11/25 09:33	1

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QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: MB 310-446646/5

Client Sample ID: Method Blank

Matrix: Water

Prep Type: Total/NA

Analysis Batch: 446646

Analyte	MB	MB	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
Tetrachloroethene	<1.00		1.00		ug/L			02/11/25 09:33	1
Toluene	<1.00		1.00		ug/L			02/11/25 09:33	1
trans-1,2-Dichloroethene	<1.00		1.00		ug/L			02/11/25 09:33	1
trans-1,3-Dichloropropene	<5.00		5.00		ug/L			02/11/25 09:33	1
1,2,3-Trichlorobenzene	<5.00		5.00		ug/L			02/11/25 09:33	1
1,2,4-Trichlorobenzene	<5.00		5.00		ug/L			02/11/25 09:33	1
1,1,1-Trichloroethane	<1.00		1.00		ug/L			02/11/25 09:33	1
1,1,2-Trichloroethane	<1.00		1.00		ug/L			02/11/25 09:33	1
Trichloroethene	<1.00		1.00		ug/L			02/11/25 09:33	1
Trichlorofluoromethane	<4.00		4.00		ug/L			02/11/25 09:33	1
1,2,3-Trichloropropane	<1.00		1.00		ug/L			02/11/25 09:33	1
1,2,4-Trimethylbenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
1,3,5-Trimethylbenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
Vinyl chloride	<1.00		1.00		ug/L			02/11/25 09:33	1
Xylenes, Total	<3.00		3.00		ug/L			02/11/25 09:33	1

Surrogate	MB	MB	Limits	Prepared	Analyzed	Dil Fac
	%Recovery	Qualifier				
4-Bromofluorobenzene (Surr)	108		80 - 120		02/11/25 09:33	1
Dibromofluoromethane (Surr)	102		73 - 130		02/11/25 09:33	1
Toluene-d8 (Surr)	95		80 - 120		02/11/25 09:33	1

Lab Sample ID: LCS 310-446646/6

Client Sample ID: Lab Control Sample

Matrix: Water

Prep Type: Total/NA

Analysis Batch: 446646

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Benzene	20.0	19.51		ug/L		98	72 - 124
Bromobenzene	20.0	19.55		ug/L		98	72 - 120
Bromochloromethane	20.0	18.61		ug/L		93	73 - 130
Bromodichloromethane	20.0	17.90		ug/L		89	74 - 122
Bromoform	20.0	19.46		ug/L		97	61 - 122
2-Butanone (MEK)	40.0	36.56		ug/L		91	50 - 150
Carbon disulfide	20.0	19.44		ug/L		97	59 - 135
Carbon tetrachloride	20.0	17.92		ug/L		90	67 - 132
Chlorobenzene	20.0	17.46		ug/L		87	76 - 120
Chlorodibromomethane	20.0	17.59		ug/L		88	71 - 121
Chloroform	20.0	19.04		ug/L		95	72 - 125
2-Chlorotoluene	20.0	20.23		ug/L		101	73 - 121
4-Chlorotoluene	20.0	19.41		ug/L		97	72 - 121
cis-1,2-Dichloroethene	20.0	19.17		ug/L		96	74 - 123
cis-1,3-Dichloropropene	20.0	19.98		ug/L		100	71 - 125
1,2-Dibromo-3-chloropropane	20.0	18.62		ug/L		93	50 - 150
1,2-Dibromoethane (EDB)	20.0	18.47		ug/L		92	75 - 125
Dibromomethane	20.0	19.34		ug/L		97	74 - 125
1,2-Dichlorobenzene	20.0	19.67		ug/L		98	74 - 120
1,3-Dichlorobenzene	20.0	18.90		ug/L		94	72 - 120
1,4-Dichlorobenzene	20.0	18.72		ug/L		94	72 - 120

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QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: LCS 310-446646/6

Matrix: Water

Analysis Batch: 446646

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
1,1-Dichloroethane	20.0	20.09		ug/L		100	70 - 127
1,2-Dichloroethane	20.0	20.05		ug/L		100	71 - 125
1,1-Dichloroethene	20.0	18.48		ug/L		92	63 - 132
1,2-Dichloropropane	20.0	18.83		ug/L		94	73 - 124
1,3-Dichloropropane	20.0	18.50		ug/L		92	72 - 125
2,2-Dichloropropane	20.0	19.07		ug/L		95	50 - 150
1,1-Dichloropropene	20.0	18.91		ug/L		95	69 - 132
Ethylbenzene	20.0	18.75		ug/L		94	74 - 122
Hexachlorobutadiene	20.0	19.63		ug/L		98	50 - 150
Hexane	20.0	20.73		ug/L		104	45 - 150
Isopropylbenzene	20.0	20.26		ug/L		101	73 - 125
Methylene chloride	20.0	20.20		ug/L		101	50 - 150
Methyl tert-butyl ether	20.0	19.11		ug/L		96	68 - 130
Naphthalene	20.0	20.60		ug/L		103	50 - 150
n-Butylbenzene	20.0	21.37		ug/L		107	67 - 131
n-Propylbenzene	20.0	21.19		ug/L		106	72 - 126
p-Isopropyltoluene	20.0	19.71		ug/L		99	70 - 127
sec-Butylbenzene	20.0	20.78		ug/L		104	70 - 127
Styrene	20.0	19.96		ug/L		100	74 - 121
tert-Butylbenzene	20.0	20.68		ug/L		103	72 - 124
1,1,1,2-Tetrachloroethane	20.0	18.61		ug/L		93	71 - 120
1,1,2,2-Tetrachloroethane	20.0	18.88		ug/L		94	68 - 124
Tetrachloroethene	20.0	18.15		ug/L		91	71 - 130
Toluene	20.0	18.81		ug/L		94	74 - 123
trans-1,2-Dichloroethene	20.0	18.10		ug/L		91	70 - 126
trans-1,3-Dichloropropene	20.0	17.93		ug/L		90	69 - 123
1,2,3-Trichlorobenzene	20.0	19.03		ug/L		95	50 - 150
1,2,4-Trichlorobenzene	20.0	19.45		ug/L		97	68 - 124
1,1,1-Trichloroethane	20.0	18.45		ug/L		92	73 - 129
1,1,2-Trichloroethane	20.0	18.05		ug/L		90	73 - 123
Trichloroethene	20.0	17.83		ug/L		89	72 - 126
1,2,3-Trichloropropane	20.0	18.94		ug/L		95	65 - 127
1,2,4-Trimethylbenzene	20.0	18.59		ug/L		93	73 - 124
1,3,5-Trimethylbenzene	20.0	20.13		ug/L		101	73 - 123
Xylenes, Total	40.0	40.14		ug/L		100	73 - 123

Surrogate	LCS %Recovery	LCS Qualifier	Limits
4-Bromofluorobenzene (Surr)	100		80 - 120
Dibromofluoromethane (Surr)	95		73 - 130
Toluene-d8 (Surr)	101		80 - 120

Lab Sample ID: LCS 310-446646/7

Matrix: Water

Analysis Batch: 446646

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Bromomethane	20.0	16.14		ug/L		81	23 - 150
Chloroethane	20.0	19.03		ug/L		95	54 - 136

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QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: LCS 310-446646/7

Matrix: Water

Analysis Batch: 446646

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike	LCS	LCS	Unit	D	%Rec	%Rec Limits
	Added	Result	Qualifier				
Chloromethane	20.0	21.26		ug/L		106	38 - 150
Dichlorodifluoromethane	20.0	18.53		ug/L		93	39 - 150
Trichlorofluoromethane	20.0	17.97		ug/L		90	54 - 149
Vinyl chloride	20.0	19.77		ug/L		99	56 - 140

Surrogate	LCS	LCS	Limits
	%Recovery	Qualifier	
4-Bromofluorobenzene (Surr)	107		80 - 120
Dibromofluoromethane (Surr)	106		73 - 130
Toluene-d8 (Surr)	94		80 - 120

Lab Sample ID: MB 310-446661/1-A

Matrix: Solid

Analysis Batch: 446663

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 446661

Analyte	MB	MB	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
Acetone	<0.101		0.101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Benzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Bromobenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Bromochloromethane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Bromodichloromethane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Bromoform	<0.0202		0.0202		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Bromomethane	<0.0403		0.0403		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
2-Butanone (MEK)	<0.0403		0.0403		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Carbon disulfide	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Carbon tetrachloride	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Chlorobenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Chlorodibromomethane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Chloroethane	<0.0403		0.0403		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Chloroform	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Chloromethane	<0.0403		0.0403		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
2-Chlorotoluene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
4-Chlorotoluene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
cis-1,2-Dichloroethene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
cis-1,3-Dichloropropene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,2-Dibromo-3-chloropropane	<0.0202		0.0202		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,2-Dibromoethane (EDB)	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Dibromomethane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,2-Dichlorobenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,3-Dichlorobenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,4-Dichlorobenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Dichlorodifluoromethane	<0.0302		0.0302		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,1-Dichloroethane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,2-Dichloroethane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,1-Dichloroethene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,2-Dichloropropane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,3-Dichloropropane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
2,2-Dichloropropane	<0.0403		0.0403		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,1-Dichloropropene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1

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QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: MB 310-446661/1-A
Matrix: Solid
Analysis Batch: 446663

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 446661

Analyte	MB	MB	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
Ethylbenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Hexachlorobutadiene	<0.0504		0.0504		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Hexane	<0.0504		0.0504		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Isopropylbenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Methylene chloride	<0.101		0.101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Methyl tert-butyl ether	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Naphthalene	<0.0504		0.0504		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
n-Butylbenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
n-Propylbenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
p-Isopropyltoluene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
sec-Butylbenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Styrene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
tert-Butylbenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,1,1,2-Tetrachloroethane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,1,2,2-Tetrachloroethane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Tetrachloroethene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Toluene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
trans-1,2-Dichloroethene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
trans-1,3-Dichloropropene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,2,3-Trichlorobenzene	<0.0202		0.0202		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,2,4-Trichlorobenzene	<0.0202		0.0202		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,1,1-Trichloroethane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,1,2-Trichloroethane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Trichloroethene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Trichlorofluoromethane	<0.0403		0.0403		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,2,3-Trichloropropane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,2,4-Trimethylbenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,3,5-Trimethylbenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Vinyl chloride	<0.0202		0.0202		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Xylenes, Total	<0.0202		0.0202		mg/Kg		02/11/25 09:03	02/11/25 11:44	1

Surrogate	MB	MB	Limits	Prepared	Analyzed	Dil Fac
	%Recovery	Qualifier				
4-Bromofluorobenzene (Surr)	98		80 - 120	02/11/25 09:03	02/11/25 11:44	1
Dibromofluoromethane (Surr)	106		80 - 127	02/11/25 09:03	02/11/25 11:44	1
Toluene-d8 (Surr)	86		80 - 120	02/11/25 09:03	02/11/25 11:44	1

Lab Sample ID: LCS 310-446661/2-A
Matrix: Solid
Analysis Batch: 446663

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 446661

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Benzene	0.0851	0.08649		mg/Kg		102	75 - 137
Bromobenzene	0.0851	0.07684		mg/Kg		90	72 - 126
Bromochloromethane	0.0851	0.08365		mg/Kg		98	74 - 142
Bromodichloromethane	0.0851	0.07314		mg/Kg		86	73 - 127
Bromoform	0.0851	0.08174		mg/Kg		96	75 - 131
2-Butanone (MEK)	0.170	0.2169		mg/Kg		127	50 - 150

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QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: LCS 310-446661/2-A

Matrix: Solid

Analysis Batch: 446663

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 446661

Analyte	Spike	LCS	LCS	Unit	D	%Rec	%Rec Limits
	Added	Result	Qualifier				
Carbon disulfide	0.0851	0.07444		mg/Kg		87	53 - 150
Carbon tetrachloride	0.0851	0.08157		mg/Kg		96	71 - 138
Chlorobenzene	0.0851	0.07383		mg/Kg		87	71 - 124
Chlorodibromomethane	0.0851	0.07895		mg/Kg		93	76 - 130
Chloroform	0.0851	0.07989		mg/Kg		94	71 - 132
2-Chlorotoluene	0.0851	0.07365		mg/Kg		87	70 - 124
4-Chlorotoluene	0.0851	0.07620		mg/Kg		89	64 - 126
cis-1,2-Dichloroethene	0.0851	0.08259		mg/Kg		97	74 - 138
cis-1,3-Dichloropropene	0.0851	0.07603		mg/Kg		89	76 - 132
1,2-Dibromo-3-chloropropane	0.0851	0.07608		mg/Kg		89	50 - 150
1,2-Dibromoethane (EDB)	0.0851	0.08084		mg/Kg		95	78 - 131
Dibromomethane	0.0851	0.09161		mg/Kg		108	75 - 139
1,2-Dichlorobenzene	0.0851	0.06948		mg/Kg		82	71 - 124
1,3-Dichlorobenzene	0.0851	0.06762		mg/Kg		79	67 - 124
1,4-Dichlorobenzene	0.0851	0.06710		mg/Kg		79	65 - 124
1,1-Dichloroethane	0.0851	0.08220		mg/Kg		97	71 - 142
1,2-Dichloroethane	0.0851	0.08772		mg/Kg		103	72 - 138
1,1-Dichloroethene	0.0851	0.07532		mg/Kg		88	59 - 150
1,2-Dichloropropane	0.0851	0.08699		mg/Kg		102	74 - 139
1,3-Dichloropropane	0.0851	0.09360		mg/Kg		110	74 - 143
2,2-Dichloropropane	0.0851	0.08279		mg/Kg		97	50 - 150
1,1-Dichloropropene	0.0851	0.08306		mg/Kg		98	72 - 137
Ethylbenzene	0.0851	0.07401		mg/Kg		87	73 - 126
Hexachlorobutadiene	0.0851	0.05914		mg/Kg		69	50 - 150
Hexane	0.0851	0.06588		mg/Kg		77	41 - 150
Isopropylbenzene	0.0851	0.07641		mg/Kg		90	73 - 126
Methylene chloride	0.0851	0.07787	J	mg/Kg		91	50 - 150
Methyl tert-butyl ether	0.0851	0.08595		mg/Kg		101	71 - 144
Naphthalene	0.0851	0.07363		mg/Kg		86	50 - 150
n-Butylbenzene	0.0851	0.06473		mg/Kg		76	59 - 128
n-Propylbenzene	0.0851	0.07457		mg/Kg		88	69 - 127
p-Isopropyltoluene	0.0851	0.06790		mg/Kg		80	66 - 125
sec-Butylbenzene	0.0851	0.06794		mg/Kg		80	71 - 124
Styrene	0.0851	0.07967		mg/Kg		94	73 - 124
tert-Butylbenzene	0.0851	0.06974		mg/Kg		82	74 - 126
1,1,1,2-Tetrachloroethane	0.0851	0.07760		mg/Kg		91	75 - 129
1,1,1,2,2-Tetrachloroethane	0.0851	0.08084		mg/Kg		95	74 - 134
Tetrachloroethene	0.0851	0.07122		mg/Kg		84	66 - 127
Toluene	0.0851	0.07279		mg/Kg		85	72 - 126
trans-1,2-Dichloroethene	0.0851	0.07636		mg/Kg		90	69 - 139
trans-1,3-Dichloropropene	0.0851	0.07823		mg/Kg		92	74 - 134
1,2,3-Trichlorobenzene	0.0851	0.06764		mg/Kg		79	50 - 150
1,2,4-Trichlorobenzene	0.0851	0.06553		mg/Kg		77	49 - 135
1,1,1-Trichloroethane	0.0851	0.08311		mg/Kg		98	75 - 136
1,1,2-Trichloroethane	0.0851	0.07765		mg/Kg		91	75 - 134
Trichloroethene	0.0851	0.08519		mg/Kg		100	73 - 134
1,2,3-Trichloropropane	0.0851	0.08085		mg/Kg		95	74 - 131
1,2,4-Trimethylbenzene	0.0851	0.06760		mg/Kg		79	66 - 128
1,3,5-Trimethylbenzene	0.0851	0.06865		mg/Kg		81	69 - 124

Eurofins Cedar Falls

QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: LCS 310-446661/2-A

Matrix: Solid

Analysis Batch: 446663

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 446661

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Xylenes, Total	0.170	0.1504		mg/Kg		88	70 - 129

Surrogate	LCS %Recovery	LCS Qualifier	Limits
4-Bromofluorobenzene (Surr)	105		80 - 120
Dibromofluoromethane (Surr)	101		80 - 127
Toluene-d8 (Surr)	91		80 - 120

Lab Sample ID: MB 310-446664/1-A

Matrix: Solid

Analysis Batch: 446665

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 446664

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<0.103		0.103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Benzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Bromobenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Bromochloromethane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Bromodichloromethane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Bromoform	<0.0206		0.0206		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Bromomethane	<0.0412		0.0412		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
2-Butanone (MEK)	<0.0412		0.0412		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Carbon disulfide	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Carbon tetrachloride	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Chlorobenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Chlorodibromomethane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Chloroethane	<0.0412		0.0412		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Chloroform	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Chloromethane	<0.0412		0.0412		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
2-Chlorotoluene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
4-Chlorotoluene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
cis-1,2-Dichloroethene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
cis-1,3-Dichloropropene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,2-Dibromo-3-chloropropane	<0.0206		0.0206		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,2-Dibromoethane (EDB)	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Dibromomethane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,2-Dichlorobenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,3-Dichlorobenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,4-Dichlorobenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Dichlorodifluoromethane	<0.0309		0.0309		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,1-Dichloroethane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,2-Dichloroethane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,1-Dichloroethene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,2-Dichloropropane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,3-Dichloropropane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
2,2-Dichloropropane	<0.0412		0.0412		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,1-Dichloropropene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Ethylbenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Hexachlorobutadiene	<0.0515		0.0515		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Hexane	<0.0515		0.0515		mg/Kg		02/11/25 09:08	02/11/25 22:57	1

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QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: MB 310-446664/1-A

Matrix: Solid

Analysis Batch: 446665

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 446664

Analyte	MB	MB	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
Isopropylbenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Methylene chloride	<0.103		0.103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Methyl tert-butyl ether	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Naphthalene	<0.0515		0.0515		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
n-Butylbenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
n-Propylbenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
p-Isopropyltoluene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
sec-Butylbenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Styrene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
tert-Butylbenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,1,1,2-Tetrachloroethane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,1,2,2-Tetrachloroethane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Tetrachloroethene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Toluene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
trans-1,2-Dichloroethene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
trans-1,3-Dichloropropene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,2,3-Trichlorobenzene	<0.0206		0.0206		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,2,4-Trichlorobenzene	<0.0206		0.0206		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,1,1-Trichloroethane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,1,2-Trichloroethane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Trichloroethene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Trichlorofluoromethane	<0.0412		0.0412		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,2,3-Trichloropropane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,2,4-Trimethylbenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,3,5-Trimethylbenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Vinyl chloride	<0.0206		0.0206		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Xylenes, Total	<0.0206		0.0206		mg/Kg		02/11/25 09:08	02/11/25 22:57	1

Surrogate	MB	MB	Limits	Prepared	Analyzed	Dil Fac
	%Recovery	Qualifier				
4-Bromofluorobenzene (Surr)	106		80 - 120	02/11/25 09:08	02/11/25 22:57	1
Dibromofluoromethane (Surr)	102		80 - 127	02/11/25 09:08	02/11/25 22:57	1
Toluene-d8 (Surr)	90		80 - 120	02/11/25 09:08	02/11/25 22:57	1

Lab Sample ID: LCS 310-446664/2-A

Matrix: Solid

Analysis Batch: 446665

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 446664

Analyte	Spike Added	LCS	LCS	Unit	D	%Rec	%Rec Limits
		Result	Qualifier				
Acetone	0.166	0.1601		mg/Kg		96	50 - 150
Benzene	0.0831	0.07794		mg/Kg		94	75 - 137
Bromobenzene	0.0831	0.06320		mg/Kg		76	72 - 126
Bromochloromethane	0.0831	0.07435		mg/Kg		90	74 - 142
Bromodichloromethane	0.0831	0.06560		mg/Kg		79	73 - 127
Bromoform	0.0831	0.06836		mg/Kg		82	75 - 131
2-Butanone (MEK)	0.166	0.1969		mg/Kg		119	50 - 150
Carbon disulfide	0.0831	0.06394		mg/Kg		77	53 - 150
Carbon tetrachloride	0.0831	0.07231		mg/Kg		87	71 - 138
Chlorobenzene	0.0831	0.06297		mg/Kg		76	71 - 124

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QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: LCS 310-446664/2-A

Matrix: Solid

Analysis Batch: 446665

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 446664

Analyte	Spike	LCS	LCS	Unit	D	%Rec	%Rec Limits
	Added	Result	Qualifier				
Chlorodibromomethane	0.0831	0.06713		mg/Kg		81	76 - 130
Chloroform	0.0831	0.07203		mg/Kg		87	71 - 132
2-Chlorotoluene	0.0831	0.06283		mg/Kg		76	70 - 124
4-Chlorotoluene	0.0831	0.05944		mg/Kg		72	64 - 126
cis-1,2-Dichloroethene	0.0831	0.07282		mg/Kg		88	74 - 138
cis-1,3-Dichloropropene	0.0831	0.06947		mg/Kg		84	76 - 132
1,2-Dibromo-3-chloropropane	0.0831	0.06919		mg/Kg		83	50 - 150
1,2-Dibromoethane (EDB)	0.0831	0.07027		mg/Kg		85	78 - 131
Dibromomethane	0.0831	0.07966		mg/Kg		96	75 - 139
1,1-Dichloroethane	0.0831	0.07573		mg/Kg		91	71 - 142
1,2-Dichloroethane	0.0831	0.07962		mg/Kg		96	72 - 138
1,1-Dichloroethene	0.0831	0.06552		mg/Kg		79	59 - 150
1,2-Dichloropropane	0.0831	0.08367		mg/Kg		101	74 - 139
1,3-Dichloropropane	0.0831	0.08455		mg/Kg		102	74 - 143
2,2-Dichloropropane	0.0831	0.07187		mg/Kg		87	50 - 150
1,1-Dichloropropene	0.0831	0.07396		mg/Kg		89	72 - 137
Ethylbenzene	0.0831	0.06481		mg/Kg		78	73 - 126
Hexachlorobutadiene	0.0831	0.04645	J	mg/Kg		56	50 - 150
Hexane	0.0831	0.05640		mg/Kg		68	41 - 150
Isopropylbenzene	0.0831	0.06592		mg/Kg		79	73 - 126
Methylene chloride	0.0831	0.07105	J	mg/Kg		86	50 - 150
Methyl tert-butyl ether	0.0831	0.07904		mg/Kg		95	71 - 144
Naphthalene	0.0831	0.06315		mg/Kg		76	50 - 150
n-Butylbenzene	0.0831	0.05148		mg/Kg		62	59 - 128
n-Propylbenzene	0.0831	0.06188		mg/Kg		75	69 - 127
p-Isopropyltoluene	0.0831	0.05658		mg/Kg		68	66 - 125
sec-Butylbenzene	0.0831	0.05919		mg/Kg		71	71 - 124
Styrene	0.0831	0.06736		mg/Kg		81	73 - 124
tert-Butylbenzene	0.0831	0.06265		mg/Kg		75	74 - 126
1,1,1,2-Tetrachloroethane	0.0831	0.06668		mg/Kg		80	75 - 129
1,1,2,2-Tetrachloroethane	0.0831	0.07265		mg/Kg		87	74 - 134
Tetrachloroethene	0.0831	0.05606		mg/Kg		67	66 - 127
Toluene	0.0831	0.06514		mg/Kg		78	72 - 126
trans-1,2-Dichloroethene	0.0831	0.06735		mg/Kg		81	69 - 139
trans-1,3-Dichloropropene	0.0831	0.07084		mg/Kg		85	74 - 134
1,2,3-Trichlorobenzene	0.0831	0.05193		mg/Kg		63	50 - 150
1,2,4-Trichlorobenzene	0.0831	0.04629		mg/Kg		56	49 - 135
1,1,1-Trichloroethane	0.0831	0.07472		mg/Kg		90	75 - 136
1,1,2-Trichloroethane	0.0831	0.07103		mg/Kg		86	75 - 134
Trichloroethene	0.0831	0.07284		mg/Kg		88	73 - 134
1,2,3-Trichloropropane	0.0831	0.07645		mg/Kg		92	74 - 131
1,2,4-Trimethylbenzene	0.0831	0.05799		mg/Kg		70	66 - 128
1,3,5-Trimethylbenzene	0.0831	0.05957		mg/Kg		72	69 - 124
Xylenes, Total	0.166	0.1279		mg/Kg		77	70 - 129

Surrogate	LCS LCS		Limits
	%Recovery	Qualifier	
4-Bromofluorobenzene (Surr)	109		80 - 120
Dibromofluoromethane (Surr)	102		80 - 127

Eurofins Cedar Falls

QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: LCS 310-446664/2-A
Matrix: Solid
Analysis Batch: 446665

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 446664

Surrogate	LCS LCS		Limits
	%Recovery	Qualifier	
Toluene-d8 (Surr)	93		80 - 120

Lab Sample ID: MB 310-446784/1-A
Matrix: Solid
Analysis Batch: 446785

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 446784

Analyte	MB MB		RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
Acetone	<0.488		0.488		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Benzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Bromobenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Bromochloromethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Bromodichloromethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Bromoform	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Bromomethane	<0.488		0.488		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
2-Butanone (MEK)	<0.731		0.731		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Carbon disulfide	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Carbon tetrachloride	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Chlorobenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Chlorodibromomethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Chloroethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Chloroform	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Chloromethane	<0.244		0.244		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
2-Chlorotoluene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
4-Chlorotoluene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
cis-1,2-Dichloroethene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
cis-1,3-Dichloropropene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,2-Dibromo-3-chloropropane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,2-Dibromoethane (EDB)	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Dibromomethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,2-Dichlorobenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,3-Dichlorobenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,4-Dichlorobenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Dichlorodifluoromethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,1-Dichloroethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,2-Dichloroethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,1-Dichloroethene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,2-Dichloropropane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,3-Dichloropropane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
2,2-Dichloropropane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,1-Dichloropropene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Ethylbenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Hexachlorobutadiene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Hexane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Isopropylbenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Methylene chloride	<0.244		0.244		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Methyl tert-butyl ether	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Naphthalene	<0.244		0.244		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
n-Butylbenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1

Eurofins Cedar Falls

QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: MB 310-446784/1-A

Matrix: Solid

Analysis Batch: 446785

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 446784

Analyte	MB	MB	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
n-Propylbenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
p-Isopropyltoluene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
sec-Butylbenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Styrene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
tert-Butylbenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,1,1,2-Tetrachloroethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,1,2,2-Tetrachloroethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Tetrachloroethene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Toluene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
trans-1,2-Dichloroethene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
trans-1,3-Dichloropropene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,2,3-Trichlorobenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,2,4-Trichlorobenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,1,1-Trichloroethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,1,2-Trichloroethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Trichloroethene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Trichlorofluoromethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,2,3-Trichloropropane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,2,4-Trimethylbenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,3,5-Trimethylbenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Vinyl chloride	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Xylenes, Total	<0.146		0.146		mg/Kg		02/13/25 07:03	02/13/25 09:35	1

Surrogate	MB	MB	Limits	Prepared	Analyzed	Dil Fac
	%Recovery	Qualifier				
4-Bromofluorobenzene (Surr)	104		80 - 120	02/13/25 07:03	02/13/25 09:35	1
Dibromofluoromethane (Surr)	108		80 - 120	02/13/25 07:03	02/13/25 09:35	1
Toluene-d8 (Surr)	102		80 - 120	02/13/25 07:03	02/13/25 09:35	1

Lab Sample ID: LCS 310-446784/2-A

Matrix: Solid

Analysis Batch: 446785

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 446784

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Benzene	0.963	0.9679		mg/Kg		100	80 - 127
Bromobenzene	0.963	0.9773		mg/Kg		101	80 - 129
Bromochloromethane	0.963	1.102		mg/Kg		114	79 - 141
Bromodichloromethane	0.963	0.9577		mg/Kg		99	72 - 126
Bromoform	0.963	1.024		mg/Kg		106	56 - 140
2-Butanone (MEK)	1.93	2.264		mg/Kg		118	50 - 150
Carbon disulfide	0.963	1.037		mg/Kg		108	63 - 136
Carbon tetrachloride	0.963	1.077		mg/Kg		112	74 - 134
Chlorobenzene	0.963	0.9757		mg/Kg		101	80 - 123
Chlorodibromomethane	0.963	1.008		mg/Kg		105	70 - 127
Chloroform	0.963	1.051		mg/Kg		109	78 - 128
2-Chlorotoluene	0.963	1.028		mg/Kg		107	80 - 123
4-Chlorotoluene	0.963	1.067		mg/Kg		111	79 - 122
cis-1,2-Dichloroethene	0.963	1.044		mg/Kg		108	80 - 131

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QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: LCS 310-446784/2-A

Matrix: Solid

Analysis Batch: 446785

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 446784

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
cis-1,3-Dichloropropene	0.963	0.9672		mg/Kg		100	77 - 127
1,2-Dibromo-3-chloropropane	0.963	0.9569		mg/Kg		99	50 - 150
1,2-Dibromoethane (EDB)	0.963	1.029		mg/Kg		107	80 - 126
Dibromomethane	0.963	1.052		mg/Kg		109	78 - 133
1,2-Dichlorobenzene	0.963	0.9584		mg/Kg		100	80 - 123
1,3-Dichlorobenzene	0.963	0.9928		mg/Kg		103	80 - 124
1,4-Dichlorobenzene	0.963	0.9466		mg/Kg		98	79 - 122
1,1-Dichloroethane	0.963	1.067		mg/Kg		111	75 - 133
1,2-Dichloroethane	0.963	1.067		mg/Kg		111	74 - 135
1,1-Dichloroethene	0.963	1.002		mg/Kg		104	72 - 136
1,2-Dichloropropane	0.963	1.015		mg/Kg		105	80 - 130
1,3-Dichloropropane	0.963	1.010		mg/Kg		105	79 - 130
2,2-Dichloropropane	0.963	1.181		mg/Kg		123	50 - 150
1,1-Dichloropropene	0.963	1.008		mg/Kg		105	80 - 131
Ethylbenzene	0.963	0.9616		mg/Kg		100	80 - 123
Hexachlorobutadiene	0.963	1.055		mg/Kg		110	50 - 150
Hexane	0.963	1.244		mg/Kg		129	45 - 150
Isopropylbenzene	0.963	0.9864		mg/Kg		102	80 - 125
Methylene chloride	0.963	1.010		mg/Kg		105	50 - 150
Methyl tert-butyl ether	0.963	1.039		mg/Kg		108	72 - 136
Naphthalene	0.963	1.003		mg/Kg		104	50 - 150
n-Butylbenzene	0.963	0.9779		mg/Kg		102	71 - 127
n-Propylbenzene	0.963	1.023		mg/Kg		106	79 - 125
p-Isopropyltoluene	0.963	0.9595		mg/Kg		100	76 - 125
sec-Butylbenzene	0.963	0.9742		mg/Kg		101	76 - 125
Styrene	0.963	0.9981		mg/Kg		104	79 - 124
tert-Butylbenzene	0.963	0.9661		mg/Kg		100	78 - 124
1,1,1,2-Tetrachloroethane	0.963	0.9971		mg/Kg		104	78 - 127
1,1,2,2-Tetrachloroethane	0.963	1.054		mg/Kg		109	74 - 131
Tetrachloroethene	0.963	0.9742		mg/Kg		101	80 - 134
Toluene	0.963	0.9202		mg/Kg		96	78 - 126
trans-1,2-Dichloroethene	0.963	1.093		mg/Kg		114	75 - 134
trans-1,3-Dichloropropene	0.963	1.012		mg/Kg		105	74 - 125
1,2,3-Trichlorobenzene	0.963	0.9848		mg/Kg		102	50 - 150
1,2,4-Trichlorobenzene	0.963	1.019		mg/Kg		106	74 - 130
1,1,1-Trichloroethane	0.963	1.017		mg/Kg		106	77 - 134
1,1,2-Trichloroethane	0.963	1.016		mg/Kg		106	80 - 127
Trichloroethene	0.963	0.9828		mg/Kg		102	80 - 130
1,2,3-Trichloropropane	0.963	1.091		mg/Kg		113	75 - 134
1,2,4-Trimethylbenzene	0.963	1.003		mg/Kg		104	73 - 130
1,3,5-Trimethylbenzene	0.963	0.9963		mg/Kg		103	76 - 124
Xylenes, Total	1.93	2.047		mg/Kg		106	80 - 125

Surrogate	LCS LCS		Limits
	%Recovery	Qualifier	
4-Bromofluorobenzene (Surr)	104		80 - 120
Dibromofluoromethane (Surr)	102		80 - 120
Toluene-d8 (Surr)	96		80 - 120

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QC Sample Results

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: MB 310-446943/1-A
Matrix: Solid
Analysis Batch: 447035

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 446943

Analyte	MB	MB	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
Acetone	<0.0500		0.0500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Benzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Bromobenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Bromochloromethane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Bromodichloromethane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Bromoform	<0.0100		0.0100		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Bromomethane	<0.0200		0.0200		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
2-Butanone (MEK)	<0.0200		0.0200		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Carbon disulfide	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Carbon tetrachloride	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Chlorobenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Chlorodibromomethane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Chloroethane	<0.0200		0.0200		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Chloroform	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Chloromethane	<0.0200		0.0200		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
2-Chlorotoluene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
4-Chlorotoluene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
cis-1,2-Dichloroethene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
cis-1,3-Dichloropropene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,2-Dibromo-3-chloropropane	<0.0100		0.0100		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,2-Dibromoethane (EDB)	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Dibromomethane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,2-Dichlorobenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,3-Dichlorobenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,4-Dichlorobenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Dichlorodifluoromethane	<0.0150		0.0150		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,1-Dichloroethane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,2-Dichloroethane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,1-Dichloroethene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,2-Dichloropropane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,3-Dichloropropane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
2,2-Dichloropropane	<0.0200		0.0200		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,1-Dichloropropene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Ethylbenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Hexachlorobutadiene	<0.0250		0.0250		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Hexane	<0.0250		0.0250		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Isopropylbenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Methylene chloride	<0.0500		0.0500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Methyl tert-butyl ether	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Naphthalene	<0.0250		0.0250		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
n-Butylbenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
n-Propylbenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
p-Isopropyltoluene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
sec-Butylbenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Styrene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
tert-Butylbenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,1,1,2-Tetrachloroethane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,1,2,2-Tetrachloroethane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1

Eurofins Cedar Falls

QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: MB 310-446943/1-A
Matrix: Solid
Analysis Batch: 447035

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 446943

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Tetrachloroethene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Toluene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
trans-1,2-Dichloroethene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
trans-1,3-Dichloropropene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,2,3-Trichlorobenzene	<0.0100		0.0100		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,2,4-Trichlorobenzene	<0.0100		0.0100		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,1,1-Trichloroethane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,1,2-Trichloroethane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Trichloroethene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Trichlorofluoromethane	<0.0200		0.0200		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,2,3-Trichloropropane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,2,4-Trimethylbenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,3,5-Trimethylbenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Vinyl chloride	<0.0100		0.0100		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Xylenes, Total	<0.0100		0.0100		mg/Kg		02/17/25 07:27	02/18/25 06:58	1

Surrogate	MB %Recovery	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	93		80 - 120	02/17/25 07:27	02/18/25 06:58	1
Dibromofluoromethane (Surr)	102		80 - 127	02/17/25 07:27	02/18/25 06:58	1
Toluene-d8 (Surr)	97		80 - 120	02/17/25 07:27	02/18/25 06:58	1

Lab Sample ID: LCS 310-446943/2-A
Matrix: Solid
Analysis Batch: 447035

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 446943

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Acetone	0.165	0.1541		mg/Kg		93	50 - 150
Benzene	0.0825	0.08104		mg/Kg		98	75 - 137
Bromobenzene	0.0825	0.08462		mg/Kg		103	72 - 126
Bromochloromethane	0.0825	0.07977		mg/Kg		97	74 - 142
Bromodichloromethane	0.0825	0.08407		mg/Kg		102	73 - 127
Bromoform	0.0825	0.08727		mg/Kg		106	75 - 131
2-Butanone (MEK)	0.165	0.1780		mg/Kg		108	50 - 150
Carbon disulfide	0.0825	0.07644		mg/Kg		93	53 - 150
Carbon tetrachloride	0.0825	0.08340		mg/Kg		101	71 - 138
Chlorobenzene	0.0825	0.08470		mg/Kg		103	71 - 124
Chlorodibromomethane	0.0825	0.08593		mg/Kg		104	76 - 130
Chloroform	0.0825	0.07807		mg/Kg		95	71 - 132
2-Chlorotoluene	0.0825	0.08604		mg/Kg		104	70 - 124
4-Chlorotoluene	0.0825	0.08677		mg/Kg		105	64 - 126
cis-1,2-Dichloroethene	0.0825	0.07874		mg/Kg		95	74 - 138
cis-1,3-Dichloropropene	0.0825	0.08639		mg/Kg		105	76 - 132
1,2-Dibromo-3-chloropropane	0.0825	0.08166		mg/Kg		99	50 - 150
1,2-Dibromoethane (EDB)	0.0825	0.08692		mg/Kg		105	78 - 131
Dibromomethane	0.0825	0.08304		mg/Kg		101	75 - 139
1,2-Dichlorobenzene	0.0825	0.08186		mg/Kg		99	71 - 124
1,3-Dichlorobenzene	0.0825	0.08282		mg/Kg		100	67 - 124
1,4-Dichlorobenzene	0.0825	0.08248		mg/Kg		100	65 - 124

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QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: LCS 310-446943/2-A

Matrix: Solid

Analysis Batch: 447035

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 446943

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
1,1-Dichloroethane	0.0825	0.07578		mg/Kg		92	71 - 142
1,2-Dichloroethane	0.0825	0.08144		mg/Kg		99	72 - 138
1,1-Dichloroethene	0.0825	0.07932		mg/Kg		96	59 - 150
1,2-Dichloropropane	0.0825	0.08288		mg/Kg		100	74 - 139
1,3-Dichloropropane	0.0825	0.08428		mg/Kg		102	74 - 143
2,2-Dichloropropane	0.0825	0.08057		mg/Kg		98	50 - 150
1,1-Dichloropropene	0.0825	0.08252		mg/Kg		100	72 - 137
Ethylbenzene	0.0825	0.08690		mg/Kg		105	73 - 126
Hexachlorobutadiene	0.0825	0.07702		mg/Kg		93	50 - 150
Hexane	0.0825	0.07488		mg/Kg		91	41 - 150
Isopropylbenzene	0.0825	0.08809		mg/Kg		107	73 - 126
Methylene chloride	0.0825	0.07133		mg/Kg		86	50 - 150
Methyl tert-butyl ether	0.0825	0.07325		mg/Kg		89	71 - 144
Naphthalene	0.0825	0.08221		mg/Kg		100	50 - 150
n-Butylbenzene	0.0825	0.08409		mg/Kg		102	59 - 128
n-Propylbenzene	0.0825	0.08808		mg/Kg		107	69 - 127
p-Isopropyltoluene	0.0825	0.08546		mg/Kg		104	66 - 125
sec-Butylbenzene	0.0825	0.08456		mg/Kg		103	71 - 124
Styrene	0.0825	0.08984		mg/Kg		109	73 - 124
tert-Butylbenzene	0.0825	0.08447		mg/Kg		102	74 - 126
1,1,1,2-Tetrachloroethane	0.0825	0.08716		mg/Kg		106	75 - 129
1,1,2,2-Tetrachloroethane	0.0825	0.08757		mg/Kg		106	74 - 134
Tetrachloroethene	0.0825	0.08408		mg/Kg		102	66 - 127
Toluene	0.0825	0.08477		mg/Kg		103	72 - 126
trans-1,2-Dichloroethene	0.0825	0.07188		mg/Kg		87	69 - 139
trans-1,3-Dichloropropene	0.0825	0.08684		mg/Kg		105	74 - 134
1,2,3-Trichlorobenzene	0.0825	0.07962		mg/Kg		97	50 - 150
1,2,4-Trichlorobenzene	0.0825	0.08021		mg/Kg		97	49 - 135
1,1,1-Trichloroethane	0.0825	0.08258		mg/Kg		100	75 - 136
1,1,2-Trichloroethane	0.0825	0.08469		mg/Kg		103	75 - 134
Trichloroethene	0.0825	0.08105		mg/Kg		98	73 - 134
1,2,3-Trichloropropane	0.0825	0.08715		mg/Kg		106	74 - 131
1,2,4-Trimethylbenzene	0.0825	0.08446		mg/Kg		102	66 - 128
1,3,5-Trimethylbenzene	0.0825	0.08448		mg/Kg		102	69 - 124
Xylenes, Total	0.165	0.1741		mg/Kg		106	70 - 129

Surrogate	LCS LCS		Limits
	%Recovery	Qualifier	
4-Bromofluorobenzene (Surr)	101		80 - 120
Dibromofluoromethane (Surr)	98		80 - 127
Toluene-d8 (Surr)	101		80 - 120

Method: 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Lab Sample ID: MB 310-446574/1-A

Matrix: Solid

Analysis Batch: 446588

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 446574

Analyte	MB MB		RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
Gasoline Range Organics [C6-C12]	<9.56		9.56		mg/Kg		02/10/25 10:41	02/11/25 13:53	1

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QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics) (Continued)

<i>Surrogate</i>	<i>MB</i> <i>%Recovery</i>	<i>MB</i> <i>Qualifier</i>	<i>Limits</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Dil Fac</i>
4-Bromofluorobenzene (Surr)	99		47 - 150	02/10/25 10:41	02/11/25 13:53	1

Lab Sample ID: LCS 310-446574/2-A
Matrix: Solid
Analysis Batch: 446588

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 446574

<i>Analyte</i>	<i>Spike</i> <i>Added</i>	<i>LCS</i> <i>Result</i>	<i>LCS</i> <i>Qualifier</i>	<i>Unit</i>	<i>D</i>	<i>%Rec</i>	<i>%Rec</i> <i>Limits</i>
Gasoline Range Organics [C6-C12]	92.4	86.50		mg/Kg		94	69 - 125

<i>Surrogate</i>	<i>LCS</i> <i>%Recovery</i>	<i>LCS</i> <i>Qualifier</i>	<i>Limits</i>
4-Bromofluorobenzene (Surr)	278	S1+	47 - 150

Lab Sample ID: MB 310-446613/5
Matrix: Water
Analysis Batch: 446613

Client Sample ID: Method Blank
Prep Type: Total/NA

<i>Analyte</i>	<i>MB</i> <i>Result</i>	<i>MB</i> <i>Qualifier</i>	<i>RL</i>	<i>MDL</i>	<i>Unit</i>	<i>D</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Dil Fac</i>
Gasoline Range Organics [C6-C12]	<500		500		ug/L			02/11/25 04:43	1

<i>Surrogate</i>	<i>MB</i> <i>%Recovery</i>	<i>MB</i> <i>Qualifier</i>	<i>Limits</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Dil Fac</i>
4-Bromofluorobenzene (Surr)	105		52 - 145		02/11/25 04:43	1

Lab Sample ID: LCS 310-446613/4
Matrix: Water
Analysis Batch: 446613

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

<i>Analyte</i>	<i>Spike</i> <i>Added</i>	<i>LCS</i> <i>Result</i>	<i>LCS</i> <i>Qualifier</i>	<i>Unit</i>	<i>D</i>	<i>%Rec</i>	<i>%Rec</i> <i>Limits</i>
Gasoline Range Organics [C6-C12]	2000	1732		ug/L		87	74 - 121

<i>Surrogate</i>	<i>LCS</i> <i>%Recovery</i>	<i>LCS</i> <i>Qualifier</i>	<i>Limits</i>
4-Bromofluorobenzene (Surr)	166	S1+	52 - 145

Lab Sample ID: MB 310-446819/1-A
Matrix: Solid
Analysis Batch: 446823

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 446819

<i>Analyte</i>	<i>MB</i> <i>Result</i>	<i>MB</i> <i>Qualifier</i>	<i>RL</i>	<i>MDL</i>	<i>Unit</i>	<i>D</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Dil Fac</i>
Gasoline Range Organics [C6-C12]	<9.22		9.22		mg/Kg		02/13/25 10:23	02/13/25 21:56	1

<i>Surrogate</i>	<i>MB</i> <i>%Recovery</i>	<i>MB</i> <i>Qualifier</i>	<i>Limits</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Dil Fac</i>
4-Bromofluorobenzene (Surr)	105		47 - 150	02/13/25 10:23	02/13/25 21:56	1

QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics) (Continued)

Lab Sample ID: LCS 310-446819/2-A
Matrix: Solid
Analysis Batch: 446823

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 446819

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Gasoline Range Organics [C6-C12]	94.6	92.76		mg/Kg		98	69 - 125
Surrogate	%Recovery	LCS Qualifier	Limits				
4-Bromofluorobenzene (Surr)	271	S1+	47 - 150				

Method: 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Lab Sample ID: MB 310-446619/1-A
Matrix: Water
Analysis Batch: 446871

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 446619

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	<300		300		ug/L		02/10/25 14:42	02/14/25 09:57	1
Surrogate	%Recovery	MB Qualifier	Limits				Prepared	Analyzed	Dil Fac
n-Octacosane	112		32 - 144				02/10/25 14:42	02/14/25 09:57	1

Lab Sample ID: LCS 310-446619/2-A
Matrix: Water
Analysis Batch: 446871

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 446619

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Diesel Range Organics [C10-C28]	4000	2971		ug/L		74	42 - 121
Surrogate	%Recovery	LCS Qualifier	Limits				
n-Octacosane	80		32 - 144				

Lab Sample ID: LCSD 310-446619/3-A
Matrix: Water
Analysis Batch: 446871

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 446619

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	Limit
Diesel Range Organics [C10-C28]	4000	2306		ug/L		58	42 - 121	25	34
Surrogate	%Recovery	LCSD Qualifier	Limits						
n-Octacosane	68		32 - 144						

Lab Sample ID: MB 310-446752/1-A
Matrix: Solid
Analysis Batch: 446787

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 446752

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	<9.79		9.79		mg/Kg		02/12/25 10:18	02/14/25 00:40	1

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QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics) (Continued)

Lab Sample ID: MB 310-446752/1-A
Matrix: Solid
Analysis Batch: 446787

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 446752

Surrogate	MB %Recovery	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
n-Octacosane	101		12 - 150	02/12/25 10:18	02/14/25 00:40	1

Lab Sample ID: LCS 310-446752/2-A
Matrix: Solid
Analysis Batch: 446787

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 446752

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Diesel Range Organics [C10-C28]	125	111.6		mg/Kg		89	54 - 121

Surrogate	LCS %Recovery	LCS Qualifier	Limits
n-Octacosane	107		12 - 150

Lab Sample ID: MB 310-446980/1-A
Matrix: Solid
Analysis Batch: 447030

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 446980

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	<10.0		10.0		mg/Kg		02/17/25 10:28	02/18/25 10:35	1

Surrogate	MB %Recovery	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
n-Octacosane	91		12 - 150	02/17/25 10:28	02/18/25 10:35	1

Lab Sample ID: LCS 310-446980/2-A
Matrix: Solid
Analysis Batch: 447030

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 446980

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Diesel Range Organics [C10-C28]	131	115.5		mg/Kg		88	54 - 121

Surrogate	LCS %Recovery	LCS Qualifier	Limits
n-Octacosane	89		12 - 150

QC Association Summary

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

GC/MS VOA

Analysis Batch: 446646

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-7	MW-02	Total/NA	Water	8260D	
310-300055-8	MW-03	Total/NA	Water	8260D	
310-300055-9	HCL Blank	Total/NA	Water	8260D	
MB 310-446646/5	Method Blank	Total/NA	Water	8260D	
LCS 310-446646/6	Lab Control Sample	Total/NA	Water	8260D	
LCS 310-446646/7	Lab Control Sample	Total/NA	Water	8260D	

Prep Batch: 446661

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-1	SB-01 (10-12.5)	Total/NA	Solid	5035	
310-300055-4	SB-04 (12.5-15)	Total/NA	Solid	5035	
310-300055-5	SB-05 (10-12.5)	Total/NA	Solid	5035	
310-300055-6	SB-06 (7.5-10)	Total/NA	Solid	5035	
MB 310-446661/1-A	Method Blank	Total/NA	Solid	5035	
LCS 310-446661/2-A	Lab Control Sample	Total/NA	Solid	5035	

Analysis Batch: 446663

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-1	SB-01 (10-12.5)	Total/NA	Solid	8260D	446661
310-300055-4	SB-04 (12.5-15)	Total/NA	Solid	8260D	446661
310-300055-5	SB-05 (10-12.5)	Total/NA	Solid	8260D	446661
310-300055-6	SB-06 (7.5-10)	Total/NA	Solid	8260D	446661
MB 310-446661/1-A	Method Blank	Total/NA	Solid	8260D	446661
LCS 310-446661/2-A	Lab Control Sample	Total/NA	Solid	8260D	446661

Prep Batch: 446664

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-3	SB-03 (7.5-10)	Total/NA	Solid	5035	
MB 310-446664/1-A	Method Blank	Total/NA	Solid	5035	
LCS 310-446664/2-A	Lab Control Sample	Total/NA	Solid	5035	

Analysis Batch: 446665

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-3	SB-03 (7.5-10)	Total/NA	Solid	8260D	446664
MB 310-446664/1-A	Method Blank	Total/NA	Solid	8260D	446664
LCS 310-446664/2-A	Lab Control Sample	Total/NA	Solid	8260D	446664

Prep Batch: 446784

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-2	SB-02 (17.5-20)	Total/NA	Solid	5035	
MB 310-446784/1-A	Method Blank	Total/NA	Solid	5035	
LCS 310-446784/2-A	Lab Control Sample	Total/NA	Solid	5035	

Analysis Batch: 446785

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-2	SB-02 (17.5-20)	Total/NA	Solid	8260D	446784
MB 310-446784/1-A	Method Blank	Total/NA	Solid	8260D	446784
LCS 310-446784/2-A	Lab Control Sample	Total/NA	Solid	8260D	446784

QC Association Summary

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

GC/MS VOA

Prep Batch: 446943

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-3	SB-03 (7.5-10)	Total/NA	Solid	5035	
MB 310-446943/1-A	Method Blank	Total/NA	Solid	5035	
LCS 310-446943/2-A	Lab Control Sample	Total/NA	Solid	5035	

Analysis Batch: 447035

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-3	SB-03 (7.5-10)	Total/NA	Solid	8260D	446943
MB 310-446943/1-A	Method Blank	Total/NA	Solid	8260D	446943
LCS 310-446943/2-A	Lab Control Sample	Total/NA	Solid	8260D	446943

GC VOA

Prep Batch: 446574

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-1	SB-01 (10-12.5)	Total/NA	Solid	5035	
310-300055-2	SB-02 (17.5-20)	Total/NA	Solid	5035	
310-300055-3	SB-03 (7.5-10)	Total/NA	Solid	5035	
310-300055-5	SB-05 (10-12.5)	Total/NA	Solid	5035	
310-300055-6	SB-06 (7.5-10)	Total/NA	Solid	5035	
MB 310-446574/1-A	Method Blank	Total/NA	Solid	5035	
LCS 310-446574/2-A	Lab Control Sample	Total/NA	Solid	5035	

Analysis Batch: 446588

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-1	SB-01 (10-12.5)	Total/NA	Solid	8015C	446574
310-300055-2	SB-02 (17.5-20)	Total/NA	Solid	8015C	446574
310-300055-3	SB-03 (7.5-10)	Total/NA	Solid	8015C	446574
310-300055-5	SB-05 (10-12.5)	Total/NA	Solid	8015C	446574
310-300055-6	SB-06 (7.5-10)	Total/NA	Solid	8015C	446574
MB 310-446574/1-A	Method Blank	Total/NA	Solid	8015C	446574
LCS 310-446574/2-A	Lab Control Sample	Total/NA	Solid	8015C	446574

Analysis Batch: 446613

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-7	MW-02	Total/NA	Water	8015C	
310-300055-8	MW-03	Total/NA	Water	8015C	
310-300055-9	HCL Blank	Total/NA	Water	8015C	
MB 310-446613/5	Method Blank	Total/NA	Water	8015C	
LCS 310-446613/4	Lab Control Sample	Total/NA	Water	8015C	

Prep Batch: 446819

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-4	SB-04 (12.5-15)	Total/NA	Solid	5035	
MB 310-446819/1-A	Method Blank	Total/NA	Solid	5035	
LCS 310-446819/2-A	Lab Control Sample	Total/NA	Solid	5035	

Analysis Batch: 446823

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-4	SB-04 (12.5-15)	Total/NA	Solid	8015C	446819
MB 310-446819/1-A	Method Blank	Total/NA	Solid	8015C	446819
LCS 310-446819/2-A	Lab Control Sample	Total/NA	Solid	8015C	446819

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QC Association Summary

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

GC Semi VOA

Prep Batch: 446619

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-7	MW-02	Total/NA	Water	3510C	
310-300055-8	MW-03	Total/NA	Water	3510C	
MB 310-446619/1-A	Method Blank	Total/NA	Water	3510C	
LCS 310-446619/2-A	Lab Control Sample	Total/NA	Water	3510C	
LCSD 310-446619/3-A	Lab Control Sample Dup	Total/NA	Water	3510C	

Prep Batch: 446752

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-1	SB-01 (10-12.5)	Total/NA	Solid	3546	
310-300055-3	SB-03 (7.5-10)	Total/NA	Solid	3546	
310-300055-4	SB-04 (12.5-15)	Total/NA	Solid	3546	
310-300055-5	SB-05 (10-12.5)	Total/NA	Solid	3546	
310-300055-6	SB-06 (7.5-10)	Total/NA	Solid	3546	
MB 310-446752/1-A	Method Blank	Total/NA	Solid	3546	
LCS 310-446752/2-A	Lab Control Sample	Total/NA	Solid	3546	

Analysis Batch: 446787

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-1	SB-01 (10-12.5)	Total/NA	Solid	8015C	446752
310-300055-3	SB-03 (7.5-10)	Total/NA	Solid	8015C	446752
310-300055-4	SB-04 (12.5-15)	Total/NA	Solid	8015C	446752
310-300055-5	SB-05 (10-12.5)	Total/NA	Solid	8015C	446752
310-300055-6	SB-06 (7.5-10)	Total/NA	Solid	8015C	446752
310-300055-7	MW-02	Total/NA	Water	8015C	446619
310-300055-8	MW-03	Total/NA	Water	8015C	446619
MB 310-446752/1-A	Method Blank	Total/NA	Solid	8015C	446752
LCS 310-446752/2-A	Lab Control Sample	Total/NA	Solid	8015C	446752

Analysis Batch: 446871

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-7	MW-02	Total/NA	Water	8015C	446619
MB 310-446619/1-A	Method Blank	Total/NA	Water	8015C	446619
LCS 310-446619/2-A	Lab Control Sample	Total/NA	Water	8015C	446619
LCSD 310-446619/3-A	Lab Control Sample Dup	Total/NA	Water	8015C	446619

Prep Batch: 446980

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-2	SB-02 (17.5-20)	Total/NA	Solid	3546	
MB 310-446980/1-A	Method Blank	Total/NA	Solid	3546	
LCS 310-446980/2-A	Lab Control Sample	Total/NA	Solid	3546	

Analysis Batch: 447030

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-2	SB-02 (17.5-20)	Total/NA	Solid	8015C	446980
MB 310-446980/1-A	Method Blank	Total/NA	Solid	8015C	446980
LCS 310-446980/2-A	Lab Control Sample	Total/NA	Solid	8015C	446980

QC Association Summary

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

General Chemistry

Analysis Batch: 446516

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-1	SB-01 (10-12.5)	Total/NA	Solid	Moisture	
310-300055-2	SB-02 (17.5-20)	Total/NA	Solid	Moisture	
310-300055-3	SB-03 (7.5-10)	Total/NA	Solid	Moisture	
310-300055-4	SB-04 (12.5-15)	Total/NA	Solid	Moisture	
310-300055-5	SB-05 (10-12.5)	Total/NA	Solid	Moisture	
310-300055-6	SB-06 (7.5-10)	Total/NA	Solid	Moisture	

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Lab Chronicle

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-01 (10-12.5)

Lab Sample ID: 310-300055-1

Date Collected: 02/04/25 11:05

Matrix: Solid

Date Received: 02/07/25 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	446516	A3GU	EET CF	02/08/25 11:49

Client Sample ID: SB-01 (10-12.5)

Lab Sample ID: 310-300055-1

Date Collected: 02/04/25 11:05

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 80.1

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	5035			446661	MZR8	EET CF	02/11/25 09:03
Total/NA	Analysis	8260D		1	446663	MZR8	EET CF	02/11/25 15:44
Total/NA	Prep	5035			446574	P5ZC	EET CF	02/10/25 10:41
Total/NA	Analysis	8015C		1	446588	P5ZC	EET CF	02/11/25 18:11
Total/NA	Prep	3546			446752	BDJ4	EET CF	02/12/25 10:18
Total/NA	Analysis	8015C		1	446787	C3AA	EET CF	02/14/25 03:04

Client Sample ID: SB-02 (17.5-20)

Lab Sample ID: 310-300055-2

Date Collected: 02/04/25 11:55

Matrix: Solid

Date Received: 02/07/25 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	446516	A3GU	EET CF	02/08/25 11:49

Client Sample ID: SB-02 (17.5-20)

Lab Sample ID: 310-300055-2

Date Collected: 02/04/25 11:55

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 80.5

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	5035			446784	MZR8	EET CF	02/13/25 07:03
Total/NA	Analysis	8260D		1	446785	MZR8	EET CF	02/13/25 17:15
Total/NA	Prep	5035			446574	P5ZC	EET CF	02/10/25 10:41
Total/NA	Analysis	8015C		1	446588	P5ZC	EET CF	02/11/25 18:37
Total/NA	Prep	3546			446980	BDJ4	EET CF	02/17/25 10:28
Total/NA	Analysis	8015C		1	447030	C3AA	EET CF	02/18/25 11:04

Client Sample ID: SB-03 (7.5-10)

Lab Sample ID: 310-300055-3

Date Collected: 02/04/25 13:55

Matrix: Solid

Date Received: 02/07/25 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	446516	A3GU	EET CF	02/08/25 11:49

Lab Chronicle

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-03 (7.5-10)

Lab Sample ID: 310-300055-3

Date Collected: 02/04/25 13:55

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 82.3

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	5035			446664	MZR8	EET CF	02/11/25 09:08
Total/NA	Analysis	8260D		1	446665	MZR8	EET CF	02/12/25 02:34
Total/NA	Prep	5035			446943	MZR8	EET CF	02/17/25 07:27
Total/NA	Analysis	8260D		1	447035	MZR8	EET CF	02/18/25 08:11
Total/NA	Prep	5035			446574	P5ZC	EET CF	02/10/25 10:41
Total/NA	Analysis	8015C		1	446588	P5ZC	EET CF	02/11/25 19:03
Total/NA	Prep	3546			446752	BDJ4	EET CF	02/12/25 10:18
Total/NA	Analysis	8015C		1	446787	C3AA	EET CF	02/14/25 03:19

Client Sample ID: SB-04 (12.5-15)

Lab Sample ID: 310-300055-4

Date Collected: 02/04/25 14:50

Matrix: Solid

Date Received: 02/07/25 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	446516	A3GU	EET CF	02/08/25 11:49

Client Sample ID: SB-04 (12.5-15)

Lab Sample ID: 310-300055-4

Date Collected: 02/04/25 14:50

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 80.8

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	5035			446661	MZR8	EET CF	02/11/25 09:03
Total/NA	Analysis	8260D		1	446663	MZR8	EET CF	02/11/25 16:08
Total/NA	Prep	5035			446819	P5ZC	EET CF	02/13/25 10:23
Total/NA	Analysis	8015C		1	446823	P5ZC	EET CF	02/14/25 00:30
Total/NA	Prep	3546			446752	BDJ4	EET CF	02/12/25 10:18
Total/NA	Analysis	8015C		1	446787	C3AA	EET CF	02/14/25 03:33

Client Sample ID: SB-05 (10-12.5)

Lab Sample ID: 310-300055-5

Date Collected: 02/04/25 15:40

Matrix: Solid

Date Received: 02/07/25 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	446516	A3GU	EET CF	02/08/25 11:49

Client Sample ID: SB-05 (10-12.5)

Lab Sample ID: 310-300055-5

Date Collected: 02/04/25 15:40

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 81.8

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	5035			446661	MZR8	EET CF	02/11/25 09:03
Total/NA	Analysis	8260D		1	446663	MZR8	EET CF	02/11/25 16:32
Total/NA	Prep	5035			446574	P5ZC	EET CF	02/10/25 10:41
Total/NA	Analysis	8015C		1	446588	P5ZC	EET CF	02/11/25 19:54
Total/NA	Prep	3546			446752	BDJ4	EET CF	02/12/25 10:18
Total/NA	Analysis	8015C		1	446787	C3AA	EET CF	02/14/25 03:48

Eurofins Cedar Falls

Lab Chronicle

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-06 (7.5-10)

Lab Sample ID: 310-300055-6

Date Collected: 02/04/25 16:15

Matrix: Solid

Date Received: 02/07/25 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	446516	A3GU	EET CF	02/08/25 11:49

Client Sample ID: SB-06 (7.5-10)

Lab Sample ID: 310-300055-6

Date Collected: 02/04/25 16:15

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 79.8

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	5035			446661	MZR8	EET CF	02/11/25 09:03
Total/NA	Analysis	8260D		1	446663	MZR8	EET CF	02/11/25 16:56
Total/NA	Prep	5035			446574	P5ZC	EET CF	02/10/25 10:41
Total/NA	Analysis	8015C		1	446588	P5ZC	EET CF	02/11/25 20:20
Total/NA	Prep	3546			446752	BDJ4	EET CF	02/12/25 10:18
Total/NA	Analysis	8015C		1	446787	C3AA	EET CF	02/14/25 04:02

Client Sample ID: MW-02

Lab Sample ID: 310-300055-7

Date Collected: 02/04/25 12:00

Matrix: Water

Date Received: 02/07/25 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	8260D		5	446646	WSE8	EET CF	02/11/25 16:42
Total/NA	Analysis	8015C		5	446613	P5ZC	EET CF	02/11/25 13:24
Total/NA	Prep	3510C			446619	AYK7	EET CF	02/10/25 14:42
Total/NA	Analysis	8015C		1	446787	C3AA	EET CF	02/13/25 18:51
Total/NA	Prep	3510C			446619	AYK7	EET CF	02/10/25 14:42
Total/NA	Analysis	8015C		50	446871	C3AA	EET CF	02/14/25 12:23

Client Sample ID: MW-03

Lab Sample ID: 310-300055-8

Date Collected: 02/04/25 14:00

Matrix: Water

Date Received: 02/07/25 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	8260D		5	446646	WSE8	EET CF	02/11/25 17:04
Total/NA	Analysis	8015C		5	446613	P5ZC	EET CF	02/11/25 13:53
Total/NA	Prep	3510C			446619	AYK7	EET CF	02/10/25 14:42
Total/NA	Analysis	8015C		1	446787	C3AA	EET CF	02/13/25 18:37

Client Sample ID: HCL Blank

Lab Sample ID: 310-300055-9

Date Collected: 02/04/25 00:00

Matrix: Water

Date Received: 02/07/25 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	8260D		1	446646	WSE8	EET CF	02/11/25 11:27
Total/NA	Analysis	8015C		1	446613	P5ZC	EET CF	02/11/25 05:12

Lab Chronicle

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Laboratory References:

EET CF = Eurofins Cedar Falls, 3019 Venture Way, Cedar Falls, IA 50613, TEL (319)277-2401

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Accreditation/Certification Summary

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Laboratory: Eurofins Cedar Falls

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
North Dakota	State	R-186	09-29-24 *

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
Moisture		Solid	Percent Moisture
Moisture		Solid	Percent Solids

* Accreditation/Certification renewal pending - accreditation/certification considered valid.



Method Summary

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method	Method Description	Protocol	Laboratory
8260D	Volatile Organic Compounds by GC/MS	SW846	EET CF
8015C	Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)	SW846	EET CF
8015C	Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)	SW846	EET CF
Moisture	Percent Moisture	EPA	EET CF
3510C	Liquid-Liquid Extraction (Separatory Funnel)	SW846	EET CF
3546	Microwave Extraction	SW846	EET CF
5030B	Purge and Trap	SW846	EET CF
5035	Purge and Trap for Methanol Extractions	SW846	EET CF
5035	Purge and Trap for Solids	SW846	EET CF

Protocol References:

EPA = US Environmental Protection Agency

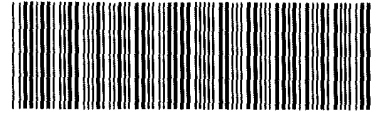
SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

EET CF = Eurofins Cedar Falls, 3019 Venture Way, Cedar Falls, IA 50613, TEL (319)277-2401



Environment Testing
America



310-300055 Chain of Custody

Cooler/Sample Receipt and Temperature Log Form

Client Information			
Client: <u>Brown</u>			
City/State:	<u>Bismark</u> <small>CITY</small>	<u>ND</u> <small>STATE</small>	Project:
Receipt Information			
Date/Time Received:	<u>2/7/25</u> <small>DATE</small>	<u>900</u> <small>TIME</small>	Received By: <u>XB</u>
Delivery Type: <input type="checkbox"/> UPS <input checked="" type="checkbox"/> FedEx <input type="checkbox"/> FedEx Ground <input type="checkbox"/> US Mail <input type="checkbox"/> Spee-Dee <input type="checkbox"/> Lab Courier <input type="checkbox"/> Lab Field Services <input type="checkbox"/> Client Drop-off <input type="checkbox"/> Other: _____			
Condition of Cooler/Containers			
Sample(s) received in Cooler?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	If yes: Cooler ID: _____	
Multiple Coolers?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	If yes: Cooler # _____ of _____	
Cooler Custody Seals Present?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	If yes: Cooler custody seals intact? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Sample Custody Seals Present?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	If yes: Sample custody seals intact? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Trip Blank Present?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	If yes: Which VOA samples are in cooler? ↓	
<u>all</u>			
Temperature Record			
Coolant:	<input checked="" type="checkbox"/> Wet ice <input type="checkbox"/> Blue ice <input type="checkbox"/> Dry ice <input type="checkbox"/> Other: _____ <input type="checkbox"/> NONE		
Thermometer ID:	<u>2</u>	Correction Factor (°C):	<u>0</u>
• Temp Blank Temperature – If no temp blank, or temp blank temperature above criteria, proceed to Sample Container Temperature			
Uncorrected Temp (°C):	<u>3.9</u>	Corrected Temp (°C):	<u>3.9</u>
• Sample Container Temperature			
Container(s) used:	<u>CONTAINER 1</u>	<u>CONTAINER 2</u>	
Uncorrected Temp (°C):			
Corrected Temp (°C):			
Exceptions Noted			
1) If temperature exceeds criteria, was sample(s) received same day of sampling? <input type="checkbox"/> Yes <input type="checkbox"/> No a) If yes: Is there evidence that the chilling process began? <input type="checkbox"/> Yes <input type="checkbox"/> No			
2) If temperature is <0°C, are there obvious signs that the integrity of sample containers is compromised? (e.g., bulging septa, broken/cracked bottles, frozen solid?) <input type="checkbox"/> Yes <input type="checkbox"/> No			
NOTE If yes, contact PM before proceeding If no, proceed with login			
Additional Comments			

Chain of Custody Record 731308



Environment Testing
America

TAL-8210

Address _____

Regulatory Program: DW NPDES RCRA Other

Client Contact		Project Manager <i>Jenna McManey</i>			Site Contact		Date <i>2/5/24</i>		COC No		
Company Name <i>Brown MCAEC</i>		Tel/Email <i>mcmaney@brownmcaec.com</i>			Lab Contact		Carrier		_____ of _____ COCs		
Address <i>2903 Morrison Ave Suite #3</i>		Analysis Turnaround Time <input type="checkbox"/> CALENDAR DAYS <input type="checkbox"/> WORKING DAYS TAT if different from Below _____ <input type="checkbox"/> 2 weeks <input checked="" type="checkbox"/> 1 week <input type="checkbox"/> 2 days <input type="checkbox"/> 1 day			Filtered Sample (Y/N) Perform MS/MSD (Y/N) TPH as DRO (Y/N) TPH GRO (Y/N) VOC EPA 8460				Sampler		
City/State/Zip <i>Bismarck ND 58504</i>									For Lab Use Only		
Phone									Walk-in Client		
Fax									Lab Sampling		
Project Name <i>Elmwood School B2500693</i>								Job / SDG No			
Site <i>Elmwood, ND</i>											
PO#											
Sample Identification		Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.			Sample Specific Notes		
SB-01 (10-12.5')		2/4/25	1105	G	S	2	X	X	X		
SB-02 (17.5-20')		2/4/25	1155	G	S	2	X	X	X		
SB-03 (7.5-10')		2/4/25	1200	G	S	2	X	X	X		
SB-04 (12.5-15')		2/4/25	1450	G	S	2	X	X	X		
SB-05 (10-12.5')		2/4/25	1540	G	S	2	X	X	X		
SB-06 (7.5-10')		2/4/25	1615	G	S	2	X	X	X		
M _{SN} -02		2/4/25	1200	G	W	8	X	X	X		
M _{SN} -03		2/4/25	1400	G	W	4	X	X	X	Low water	
Preservation Used: 1= Ice, 2= HCl, 3= H2SO4, 4= HNO3, 5= NaOH, 6= Other											
Possible Hazard Identification Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample						Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)					
<input type="checkbox"/> Non-Hazard <input type="checkbox"/> Flammable <input type="checkbox"/> Skin Irritant <input type="checkbox"/> Poison B <input type="checkbox"/> Unknown						<input type="checkbox"/> Return to Client <input type="checkbox"/> Disposal by Lab <input type="checkbox"/> Archive for _____ Months					
Special Instructions/QC Requirements & Comments											
Custody Seals Intact: <input type="checkbox"/> Yes <input type="checkbox"/> No		Custody Seal No			Cooler Temp (°C) Obs'd _____		Corr'd _____		Therm ID No _____		
Relinquished by <i>Jenna McManey</i>		Company <i>Brown</i>		Date/Time <i>2/4/25 1200</i>		Received by		Company		Date/Time	
Relinquished by		Company		Date/Time		Received by		Company		Date/Time	
Relinquished by		Company		Date/Time		Received in Laboratory by <i>pt</i>		Company		Date/Time <i>2-7-25 9:00</i>	

2/11/2025



Login Sample Receipt Checklist

Client: Braun Intertec Corporation

Job Number: 310-300055-1

SDG Number: B2500693

Login Number: 300055

List Number: 1

Creator: Hirsch, Preston

List Source: Eurofins Cedar Falls

Question	Answer	Comment
Radioactivity wasn't checked or is <=/ background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	





ANALYTICAL REPORT

PREPARED FOR

Attn: Jenna McCauley
Braun Intertec Corporation
2908 Morrison Avenue
Suite #3
Bismark, North Dakota 58504

Generated 2/18/2025 1:07:53 PM

JOB DESCRIPTION

Ellendale School
B2500693

JOB NUMBER

310-300055-1

Eurofins Cedar Falls

Job Notes

This report may not be reproduced except in full, and with written approval from the laboratory. The results relate only to the samples tested. For questions please contact the Project Manager at the e-mail address or telephone number listed on this page.

The test results in this report relate only to the samples as received by the laboratory and will meet all requirements of the methodology, with any exceptions noted. This report shall not be reproduced except in full, without the express written approval of the laboratory. All questions should be directed to the Eurofins Environment Testing North Central, LLC Project Manager.

Authorization



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2/18/2025 1:07:53 PM

Authorized for release by
Zach Bindert, Senior Project Manager
Zach.Bindert@et.eurofinsus.com
(319)595-2016



Table of Contents

Cover Page	1
Table of Contents	3
Case Narrative	4
Sample Summary	6
Detection Summary	7
Client Sample Results	9
Definitions	27
Surrogate Summary	28
QC Sample Results	31
QC Association	49
Chronicle	53
Certification Summary	57
Method Summary	58
Chain of Custody	59
Receipt Checklists	61

Case Narrative

Client: Braun Intertec Corporation
Project: Ellendale School

Job ID: 310-300055-1

Job ID: 310-300055-1

Eurofins Cedar Falls

Job Narrative 310-300055-1

Analytical test results meet all requirements of the associated regulatory program listed on the Accreditation/Certification Summary Page unless otherwise noted under the individual analysis. Data qualifiers and/or narrative comments are included to explain any exceptions, if applicable.

- Matrix QC may not be reported if insufficient sample is provided or site-specific QC samples were not submitted. In these situations, to demonstrate precision and accuracy at a batch level, a LCS/LCSD may be performed, unless otherwise specified in the method.
- Surrogate and/or isotope dilution analyte recoveries (if applicable) which are outside of the QC window are confirmed unless attributed to a dilution or otherwise noted in the narrative.

Regulated compliance samples (e.g. SDWA, NPDES) must comply with the associated agency requirements/permits.

Receipt

The samples were received on 2/7/2025 9:00 AM. Unless otherwise noted below, the samples arrived in good condition, and, where required, properly preserved and on ice. The temperature of the cooler at receipt time was 3.9°C.

GC/MS VOA

Method 8260D: The following sample was collected in a properly preserved vial; however, the pH was outside the required criteria when verified by the laboratory. The samples were analyzed within the 7-day holding time specified for unpreserved samples: MW-02 (310-300055-7) and MW-03 (310-300055-8).

Method 8260D: The method requirement for no headspace was not met. The following volatile samples were analyzed with headspace in the sample container: MW-02 (310-300055-7) and MW-03 (310-300055-8).

Method 8260D: The following samples were diluted due to the nature of the sample matrix which included excessive sediment: MW-02 (310-300055-7) and MW-03 (310-300055-8). Elevated reporting limits (RLs) are provided.

Method 8260D: The continuing calibration verification (CCV) associated with batch 310-446646 recovered above the upper control limit for Bromoform (22.7%D). The LCS associated with this CCV passed CCV criteria for the affected analyte; therefore, the data have been reported. The associated sample is impacted: (CCV 310-446646/3).

Method 8260D: The continuing calibration verification (CCV) associated with batch 310-446785 recovered above the upper control limit for Carbon tetrachloride(22.8%D), Acetone(24.5%D), and 2,2-Dichloropropane(37.4%D). The samples associated with this CCV were non-detects for the affected analytes; therefore, the data have been reported. The associated sample is impacted: (CCV 310-446785/3).

Method 8260D: The continuing calibration verification (CCV) associated with batch 310-446785 recovered above the upper control limit for Chloroethane(23.6%D) and Trichlorofluoromethane(35.8%D). The samples associated with this CCV were non-detects for the affected analytes; therefore, the data have been reported. The associated sample is impacted: (CCV 310-446785/4).

Method 8260D: The continuing calibration verification (CCV) associated with batch 310-446663 recovered above the upper control limit for Dibromomethane(21.8%D) and 1,3-Dichloropropane(23.5%D). The samples associated with this CCV were non-detects for the affected analytes; therefore, the data have been reported. The associated sample is impacted: (CCV 310-446663/3).

Method 8260D: The continuing calibration verification (CCV) associated with batch 310-446665 recovered above the upper control limit for 1,3-Dichloropropane(23.3%D), 2-Butanone(52.1%D), and 1,2-Dichloropropane(26.5%D). The samples associated with this CCV were non-detects for the affected analytes; therefore, the data have been reported. The associated sample is impacted: (CCV 310-446665/3).

No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

Gasoline Range Organics

Method 8015C_GRO: The surrogate recovery for the LCS associated with analytical batch 310-446613 was outside the upper control limits.

Method 8015C_GRO: The method requirement for no headspace was not met. The following volatile samples were analyzed with headspace in the sample container(s): MW-02 (310-300055-7) and MW-03 (310-300055-8).

Eurofins Cedar Falls

Case Narrative

Client: Braun Intertec Corporation
Project: Ellendale School

Job ID: 310-300055-1

Job ID: 310-300055-1 (Continued)

Eurofins Cedar Falls

Method 8015C_GRO: The following samples were diluted due to excessive sediment in the samples: MW-02 (310-300055-7) and MW-03 (310-300055-8). Elevated reporting limits (RLs) are provided.

Method 8015C_GRO: The following sample(s) was collected in a properly preserved vial; however, the pH was outside the required criteria when verified by the laboratory. The samples were analyzed within the 7-day holding time specified for unpreserved samples: MW-02 (310-300055-7) and MW-03 (310-300055-8).

Method 8015C_GRO: The surrogate recovery for the LCS associated with preparation batch 310-446574 and analytical batch 310-446588 was outside the upper control limits.

Method 8015C_GRO: Surrogate recovery for the following samples were outside control limits: SB-03 (7.5-10) (310-300055-3), SB-05 (10-12.5) (310-300055-5) and SB-06 (7.5-10) (310-300055-6). Evidence of matrix interference is present; therefore, re-extraction and/or re-analysis was not performed.

Method 8015C_GRO: The surrogate recovery for the LCS associated with preparation batch 310-446819 and analytical batch 310-446823 was outside the upper control limits.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

Diesel Range Organics

Method 8015C_DRO: The following samples were provided to the laboratory with a significantly different initial weight than that required by the reference method: SB-01 (10-12.5) (310-300055-1), SB-03 (7.5-10) (310-300055-3), SB-04 (12.5-15) (310-300055-4), SB-05 (10-12.5) (310-300055-5) and SB-06 (7.5-10) (310-300055-6). The method requires 15g. The amount provided was below this range. less was used to prevent drying out

Method 8015C_DRO: The following sample was provided to the laboratory with a significantly different initial weight than that required by the reference method: SB-02 (17.5-20) (310-300055-2). The method requires 15g. The amount provided was below this range. Less was used to prevent drying out

No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

General Chemistry

No additional analytical or quality issues were noted, other than those described above or in the Definitions/ Glossary page.

Eurofins Cedar Falls

Sample Summary

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
310-300055-1	SB-01 (10-12.5)	Solid	02/04/25 11:05	02/07/25 09:00
310-300055-2	SB-02 (17.5-20)	Solid	02/04/25 11:55	02/07/25 09:00
310-300055-3	SB-03 (7.5-10)	Solid	02/04/25 13:55	02/07/25 09:00
310-300055-4	SB-04 (12.5-15)	Solid	02/04/25 14:50	02/07/25 09:00
310-300055-5	SB-05 (10-12.5)	Solid	02/04/25 15:40	02/07/25 09:00
310-300055-6	SB-06 (7.5-10)	Solid	02/04/25 16:15	02/07/25 09:00
310-300055-7	MW-02	Water	02/04/25 12:00	02/07/25 09:00
310-300055-8	MW-03	Water	02/04/25 14:00	02/07/25 09:00
310-300055-9	HCL Blank	Water	02/04/25 00:00	02/07/25 09:00

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- 15

Detection Summary

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-01 (10-12.5)

Lab Sample ID: 310-300055-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Acetone	0.175		0.131		mg/Kg	1	✳	8260D	Total/NA
n-Butylbenzene	0.0248		0.0131		mg/Kg	1	✳	8260D	Total/NA
sec-Butylbenzene	0.0275		0.0131		mg/Kg	1	✳	8260D	Total/NA
1,2,4-Trimethylbenzene	0.0855		0.0131		mg/Kg	1	✳	8260D	Total/NA
1,3,5-Trimethylbenzene	0.0281		0.0131		mg/Kg	1	✳	8260D	Total/NA

Client Sample ID: SB-02 (17.5-20)

Lab Sample ID: 310-300055-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Isopropylbenzene	0.154		0.144		mg/Kg	1	✳	8260D	Total/NA
Naphthalene	2.37		0.361		mg/Kg	1	✳	8260D	Total/NA
n-Butylbenzene	1.20		0.144		mg/Kg	1	✳	8260D	Total/NA
n-Propylbenzene	0.344		0.144		mg/Kg	1	✳	8260D	Total/NA
p-Isopropyltoluene	0.485		0.144		mg/Kg	1	✳	8260D	Total/NA
sec-Butylbenzene	0.555		0.144		mg/Kg	1	✳	8260D	Total/NA
1,2,4-Trimethylbenzene	0.507		0.144		mg/Kg	1	✳	8260D	Total/NA
1,3,5-Trimethylbenzene	0.728		0.144		mg/Kg	1	✳	8260D	Total/NA
Gasoline Range Organics [C6-C12]	191		14.5		mg/Kg	1	✳	8015C	Total/NA
Diesel Range Organics [C10-C28]	248		12.4		mg/Kg	1	✳	8015C	Total/NA

Client Sample ID: SB-03 (7.5-10)

Lab Sample ID: 310-300055-3

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Ethylbenzene	0.0237		0.0132		mg/Kg	1	✳	8260D	Total/NA
Isopropylbenzene	0.0563		0.0132		mg/Kg	1	✳	8260D	Total/NA
n-Propylbenzene	0.101		0.0132		mg/Kg	1	✳	8260D	Total/NA
p-Isopropyltoluene	0.0890		0.0132		mg/Kg	1	✳	8260D	Total/NA
sec-Butylbenzene	0.0667		0.0132		mg/Kg	1	✳	8260D	Total/NA
1,2,4-Trimethylbenzene	0.0747		0.0132		mg/Kg	1	✳	8260D	Total/NA
1,3,5-Trimethylbenzene	0.390		0.0132		mg/Kg	1	✳	8260D	Total/NA
Gasoline Range Organics [C6-C12]	382		13.4		mg/Kg	1	✳	8015C	Total/NA
Diesel Range Organics [C10-C28]	4120		40.8		mg/Kg	1	✳	8015C	Total/NA

Client Sample ID: SB-04 (12.5-15)

Lab Sample ID: 310-300055-4

No Detections.

Client Sample ID: SB-05 (10-12.5)

Lab Sample ID: 310-300055-5

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Gasoline Range Organics [C6-C12]	73.1		14.3		mg/Kg	1	✳	8015C	Total/NA
Diesel Range Organics [C10-C28]	732		32.2		mg/Kg	1	✳	8015C	Total/NA

Client Sample ID: SB-06 (7.5-10)

Lab Sample ID: 310-300055-6

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Ethylbenzene	0.0221		0.0148		mg/Kg	1	✳	8260D	Total/NA
Isopropylbenzene	0.0177		0.0148		mg/Kg	1	✳	8260D	Total/NA
Naphthalene	0.422		0.0741		mg/Kg	1	✳	8260D	Total/NA
n-Butylbenzene	0.0671		0.0148		mg/Kg	1	✳	8260D	Total/NA
n-Propylbenzene	0.0464		0.0148		mg/Kg	1	✳	8260D	Total/NA
p-Isopropyltoluene	0.0194		0.0148		mg/Kg	1	✳	8260D	Total/NA
sec-Butylbenzene	0.0205		0.0148		mg/Kg	1	✳	8260D	Total/NA
1,2,4-Trimethylbenzene	0.0370		0.0148		mg/Kg	1	✳	8260D	Total/NA

This Detection Summary does not include radiochemical test results.

Eurofins Cedar Falls

Detection Summary

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

Client Sample ID: SB-06 (7.5-10) (Continued)

Lab Sample ID: 310-300055-6

Analyte	Result	Qualifier	RL	MDL	Unit	Dil	Fac	D	Method	Prep Type
1,3,5-Trimethylbenzene	0.106		0.0148		mg/Kg	1		☼	8260D	Total/NA
Gasoline Range Organics [C6-C12]	204		14.1		mg/Kg	1		☼	8015C	Total/NA
Diesel Range Organics [C10-C28]	821		33.7		mg/Kg	1		☼	8015C	Total/NA

Client Sample ID: MW-02

Lab Sample ID: 310-300055-7

Analyte	Result	Qualifier	RL	MDL	Unit	Dil	Fac	D	Method	Prep Type
Benzene	8.78		2.50		ug/L	5			8260D	Total/NA
Ethylbenzene	12.9		5.00		ug/L	5			8260D	Total/NA
Hexane	5.58		5.00		ug/L	5			8260D	Total/NA
Isopropylbenzene	27.1		5.00		ug/L	5			8260D	Total/NA
Naphthalene	998		25.0		ug/L	5			8260D	Total/NA
n-Butylbenzene	114		5.00		ug/L	5			8260D	Total/NA
n-Propylbenzene	46.7		5.00		ug/L	5			8260D	Total/NA
p-Isopropyltoluene	34.8		5.00		ug/L	5			8260D	Total/NA
sec-Butylbenzene	38.0		5.00		ug/L	5			8260D	Total/NA
1,2,4-Trimethylbenzene	129		5.00		ug/L	5			8260D	Total/NA
1,3,5-Trimethylbenzene	229		5.00		ug/L	5			8260D	Total/NA
Gasoline Range Organics [C6-C12]	8100		2500		ug/L	5			8015C	Total/NA
Diesel Range Organics [C10-C28]	5290000		25600		ug/L	50			8015C	Total/NA

Client Sample ID: MW-03

Lab Sample ID: 310-300055-8

Analyte	Result	Qualifier	RL	MDL	Unit	Dil	Fac	D	Method	Prep Type
n-Butylbenzene	9.39		5.00		ug/L	5			8260D	Total/NA
n-Propylbenzene	7.54		5.00		ug/L	5			8260D	Total/NA
1,2,4-Trimethylbenzene	7.98		5.00		ug/L	5			8260D	Total/NA
1,3,5-Trimethylbenzene	32.9		5.00		ug/L	5			8260D	Total/NA
Diesel Range Organics [C10-C28]	964		341		ug/L	1			8015C	Total/NA

Client Sample ID: HCL Blank

Lab Sample ID: 310-300055-9

No Detections.

This Detection Summary does not include radiochemical test results.

Eurofins Cedar Falls

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-01 (10-12.5)

Lab Sample ID: 310-300055-1

Date Collected: 02/04/25 11:05

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 80.1

Method: SW846 8260D - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	0.175		0.131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Benzene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Bromobenzene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Bromochloromethane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Bromodichloromethane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Bromoform	<0.0263		0.0263		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Bromomethane	<0.0526		0.0526		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
2-Butanone (MEK)	<0.0526		0.0526		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Carbon disulfide	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Carbon tetrachloride	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Chlorobenzene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Chlorodibromomethane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Chloroethane	<0.0526		0.0526		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Chloroform	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Chloromethane	<0.0526		0.0526		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
2-Chlorotoluene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
4-Chlorotoluene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
cis-1,2-Dichloroethene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
cis-1,3-Dichloropropene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,2-Dibromo-3-chloropropane	<0.0263		0.0263		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,2-Dibromoethane (EDB)	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Dibromomethane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,2-Dichlorobenzene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,3-Dichlorobenzene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,4-Dichlorobenzene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Dichlorodifluoromethane	<0.0394		0.0394		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,1-Dichloroethane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,2-Dichloroethane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,1-Dichloroethene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,2-Dichloropropane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,3-Dichloropropane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
2,2-Dichloropropane	<0.0526		0.0526		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,1-Dichloropropene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Ethylbenzene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Hexachlorobutadiene	<0.0657		0.0657		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Hexane	<0.0657		0.0657		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Isopropylbenzene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Methylene chloride	<0.131		0.131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Methyl tert-butyl ether	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Naphthalene	<0.0657		0.0657		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
n-Butylbenzene	0.0248		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
n-Propylbenzene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
p-Isopropyltoluene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
sec-Butylbenzene	0.0275		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Styrene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
tert-Butylbenzene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,1,1,2-Tetrachloroethane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,1,2,2-Tetrachloroethane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Tetrachloroethene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1

Eurofins Cedar Falls

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-01 (10-12.5)

Lab Sample ID: 310-300055-1

Date Collected: 02/04/25 11:05

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 80.1

Method: SW846 8260D - Volatile Organic Compounds by GC/MS (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Toluene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
trans-1,2-Dichloroethene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
trans-1,3-Dichloropropene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,2,3-Trichlorobenzene	<0.0263		0.0263		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,2,4-Trichlorobenzene	<0.0263		0.0263		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,1,1-Trichloroethane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,1,2-Trichloroethane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Trichloroethene	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Trichlorofluoromethane	<0.0526		0.0526		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,2,3-Trichloropropane	<0.0131		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,2,4-Trimethylbenzene	0.0855		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
1,3,5-Trimethylbenzene	0.0281		0.0131		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Vinyl chloride	<0.0263		0.0263		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Xylenes, Total	<0.0263		0.0263		mg/Kg	☼	02/11/25 09:03	02/11/25 15:44	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	101		80 - 120				02/11/25 09:03	02/11/25 15:44	1
Dibromofluoromethane (Surr)	107		80 - 127				02/11/25 09:03	02/11/25 15:44	1
Toluene-d8 (Surr)	86		80 - 120				02/11/25 09:03	02/11/25 15:44	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Gasoline Range Organics [C6-C12]	<14.4		14.4		mg/Kg	☼	02/10/25 10:41	02/11/25 18:11	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	100		47 - 150				02/10/25 10:41	02/11/25 18:11	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	<32.3		32.3		mg/Kg	☼	02/12/25 10:18	02/14/25 03:04	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
n-Octacosane	42		12 - 150				02/12/25 10:18	02/14/25 03:04	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	19.9		0.1		%			02/08/25 11:49	1
Percent Solids (EPA Moisture)	80.1		0.1		%			02/08/25 11:49	1

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-02 (17.5-20)

Lab Sample ID: 310-300055-2

Date Collected: 02/04/25 11:55

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 80.5

Method: SW846 8260D - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<0.722		0.722		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Benzene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Bromobenzene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Bromochloromethane	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Bromodichloromethane	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Bromoform	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Bromomethane	<0.722		0.722		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
2-Butanone (MEK)	<1.08		1.08		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Carbon disulfide	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Carbon tetrachloride	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Chlorobenzene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Chlorodibromomethane	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Chloroethane	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Chloroform	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Chloromethane	<0.361		0.361		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
2-Chlorotoluene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
4-Chlorotoluene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
cis-1,2-Dichloroethene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
cis-1,3-Dichloropropene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
1,2-Dibromo-3-chloropropane	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
1,2-Dibromoethane (EDB)	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Dibromomethane	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
1,2-Dichlorobenzene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
1,3-Dichlorobenzene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
1,4-Dichlorobenzene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Dichlorodifluoromethane	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
1,1-Dichloroethane	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
1,2-Dichloroethane	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
1,1-Dichloroethene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
1,2-Dichloropropane	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
1,3-Dichloropropane	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
2,2-Dichloropropane	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
1,1-Dichloropropene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Ethylbenzene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Hexachlorobutadiene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Hexane	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Isopropylbenzene	0.154		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Methylene chloride	<0.361		0.361		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Methyl tert-butyl ether	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Naphthalene	2.37		0.361		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
n-Butylbenzene	1.20		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
n-Propylbenzene	0.344		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
p-Isopropyltoluene	0.485		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
sec-Butylbenzene	0.555		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Styrene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
tert-Butylbenzene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
1,1,1,2-Tetrachloroethane	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
1,1,2,2-Tetrachloroethane	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1
Tetrachloroethene	<0.144		0.144		mg/Kg	✳	02/13/25 07:03	02/13/25 17:15	1

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Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-02 (17.5-20)

Lab Sample ID: 310-300055-2

Date Collected: 02/04/25 11:55

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 80.5

Method: SW846 8260D - Volatile Organic Compounds by GC/MS (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Toluene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
trans-1,2-Dichloroethene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
trans-1,3-Dichloropropene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
1,2,3-Trichlorobenzene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
1,2,4-Trichlorobenzene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
1,1,1-Trichloroethane	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
1,1,2-Trichloroethane	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Trichloroethene	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Trichlorofluoromethane	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
1,2,3-Trichloropropane	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
1,2,4-Trimethylbenzene	0.507		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
1,3,5-Trimethylbenzene	0.728		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Vinyl chloride	<0.144		0.144		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Xylenes, Total	<0.217		0.217		mg/Kg	✱	02/13/25 07:03	02/13/25 17:15	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	97		80 - 120				02/13/25 07:03	02/13/25 17:15	1
Dibromofluoromethane (Surr)	108		80 - 120				02/13/25 07:03	02/13/25 17:15	1
Toluene-d8 (Surr)	100		80 - 120				02/13/25 07:03	02/13/25 17:15	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Gasoline Range Organics [C6-C12]	191		14.5		mg/Kg	✱	02/10/25 10:41	02/11/25 18:37	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	122		47 - 150				02/10/25 10:41	02/11/25 18:37	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	248		12.4		mg/Kg	✱	02/17/25 10:28	02/18/25 11:04	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
n-Octacosane	74		12 - 150				02/17/25 10:28	02/18/25 11:04	1

General Chemistry

Analyte	Result	Qualifier	RL	RL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	19.5		0.1		%			02/08/25 11:49	1
Percent Solids (EPA Moisture)	80.5		0.1		%			02/08/25 11:49	1

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-03 (7.5-10)

Lab Sample ID: 310-300055-3

Date Collected: 02/04/25 13:55

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 82.3

Method: SW846 8260D - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<0.132		0.132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Benzene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Bromobenzene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Bromochloromethane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Bromodichloromethane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Bromoform	<0.0263		0.0263		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Bromomethane	<0.0526		0.0526		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
2-Butanone (MEK)	<0.0526		0.0526		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Carbon disulfide	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Carbon tetrachloride	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Chlorobenzene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Chlorodibromomethane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Chloroethane	<0.0526		0.0526		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Chloroform	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Chloromethane	<0.0526		0.0526		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
2-Chlorotoluene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
4-Chlorotoluene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
cis-1,2-Dichloroethene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
cis-1,3-Dichloropropene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
1,2-Dibromo-3-chloropropane	<0.0263		0.0263		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
1,2-Dibromoethane (EDB)	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Dibromomethane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
1,2-Dichlorobenzene	<0.00608		0.00608		mg/Kg	✱	02/17/25 07:27	02/18/25 08:11	1
1,3-Dichlorobenzene	<0.00608		0.00608		mg/Kg	✱	02/17/25 07:27	02/18/25 08:11	1
1,4-Dichlorobenzene	<0.00608		0.00608		mg/Kg	✱	02/17/25 07:27	02/18/25 08:11	1
Dichlorodifluoromethane	<0.0182		0.0182		mg/Kg	✱	02/17/25 07:27	02/18/25 08:11	1
1,1-Dichloroethane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
1,2-Dichloroethane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
1,1-Dichloroethene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
1,2-Dichloropropane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
1,3-Dichloropropane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
2,2-Dichloropropane	<0.0526		0.0526		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
1,1-Dichloropropene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Ethylbenzene	0.0237		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Hexachlorobutadiene	<0.0658		0.0658		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Hexane	<0.0658		0.0658		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Isopropylbenzene	0.0563		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Methylene chloride	<0.132		0.132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Methyl tert-butyl ether	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Naphthalene	<0.0658		0.0658		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
n-Butylbenzene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
n-Propylbenzene	0.101		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
p-Isopropyltoluene	0.0890		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
sec-Butylbenzene	0.0667		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Styrene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
tert-Butylbenzene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
1,1,1,2-Tetrachloroethane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
1,1,2,2-Tetrachloroethane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1
Tetrachloroethene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:08	02/12/25 02:34	1

Eurofins Cedar Falls

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-03 (7.5-10)

Lab Sample ID: 310-300055-3

Date Collected: 02/04/25 13:55

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 82.3

Method: SW846 8260D - Volatile Organic Compounds by GC/MS (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Toluene	<0.0132		0.0132		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
trans-1,2-Dichloroethene	<0.0132		0.0132		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
trans-1,3-Dichloropropene	<0.0132		0.0132		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
1,2,3-Trichlorobenzene	<0.0263		0.0263		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
1,2,4-Trichlorobenzene	<0.0263		0.0263		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
1,1,1-Trichloroethane	<0.0132		0.0132		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
1,1,2-Trichloroethane	<0.0132		0.0132		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
Trichloroethene	<0.0132		0.0132		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
Trichlorofluoromethane	<0.0526		0.0526		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
1,2,3-Trichloropropane	<0.0132		0.0132		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
1,2,4-Trimethylbenzene	0.0747		0.0132		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
1,3,5-Trimethylbenzene	0.390		0.0132		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
Vinyl chloride	<0.0263		0.0263		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1
Xylenes, Total	<0.0263		0.0263		mg/Kg	☼	02/11/25 09:08	02/12/25 02:34	1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	91		80 - 120	02/11/25 09:08	02/12/25 02:34	1
4-Bromofluorobenzene (Surr)	86		80 - 120	02/17/25 07:27	02/18/25 08:11	1
Dibromofluoromethane (Surr)	100		80 - 127	02/11/25 09:08	02/12/25 02:34	1
Dibromofluoromethane (Surr)	98		80 - 127	02/17/25 07:27	02/18/25 08:11	1
Toluene-d8 (Surr)	85		80 - 120	02/11/25 09:08	02/12/25 02:34	1
Toluene-d8 (Surr)	94		80 - 120	02/17/25 07:27	02/18/25 08:11	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Gasoline Range Organics [C6-C12]	382		13.4		mg/Kg	☼	02/10/25 10:41	02/11/25 19:03	1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	161	S1+	47 - 150	02/10/25 10:41	02/11/25 19:03	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	4120		40.8		mg/Kg	☼	02/12/25 10:18	02/14/25 03:19	1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
n-Octacosane	59		12 - 150	02/12/25 10:18	02/14/25 03:19	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	17.7		0.1		%			02/08/25 11:49	1
Percent Solids (EPA Moisture)	82.3		0.1		%			02/08/25 11:49	1

Client Sample Results

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

Client Sample ID: SB-04 (12.5-15)

Lab Sample ID: 310-300055-4

Date Collected: 02/04/25 14:50

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 80.8

Method: SW846 8260D - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<0.132		0.132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Benzene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Bromobenzene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Bromochloromethane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Bromodichloromethane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Bromoform	<0.0263		0.0263		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Bromomethane	<0.0526		0.0526		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
2-Butanone (MEK)	<0.0526		0.0526		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Carbon disulfide	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Carbon tetrachloride	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Chlorobenzene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Chlorodibromomethane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Chloroethane	<0.0526		0.0526		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Chloroform	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Chloromethane	<0.0526		0.0526		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
2-Chlorotoluene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
4-Chlorotoluene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
cis-1,2-Dichloroethene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
cis-1,3-Dichloropropene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
1,2-Dibromo-3-chloropropane	<0.0263		0.0263		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
1,2-Dibromoethane (EDB)	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Dibromomethane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
1,2-Dichlorobenzene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
1,3-Dichlorobenzene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
1,4-Dichlorobenzene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Dichlorodifluoromethane	<0.0395		0.0395		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
1,1-Dichloroethane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
1,2-Dichloroethane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
1,1-Dichloroethene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
1,2-Dichloropropane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
1,3-Dichloropropane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
2,2-Dichloropropane	<0.0526		0.0526		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
1,1-Dichloropropene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Ethylbenzene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Hexachlorobutadiene	<0.0658		0.0658		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Hexane	<0.0658		0.0658		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Isopropylbenzene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Methylene chloride	<0.132		0.132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Methyl tert-butyl ether	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Naphthalene	<0.0658		0.0658		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
n-Butylbenzene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
n-Propylbenzene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
p-Isopropyltoluene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
sec-Butylbenzene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Styrene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
tert-Butylbenzene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
1,1,1,2-Tetrachloroethane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
1,1,2,2-Tetrachloroethane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Tetrachloroethene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1

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Client Sample Results

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

Client Sample ID: SB-04 (12.5-15)

Lab Sample ID: 310-300055-4

Date Collected: 02/04/25 14:50

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 80.8

Method: SW846 8260D - Volatile Organic Compounds by GC/MS (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Toluene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
trans-1,2-Dichloroethene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
trans-1,3-Dichloropropene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
1,2,3-Trichlorobenzene	<0.0263		0.0263		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
1,2,4-Trichlorobenzene	<0.0263		0.0263		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
1,1,1-Trichloroethane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
1,1,2-Trichloroethane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Trichloroethene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Trichlorofluoromethane	<0.0526		0.0526		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
1,2,3-Trichloropropane	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
1,2,4-Trimethylbenzene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
1,3,5-Trimethylbenzene	<0.0132		0.0132		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Vinyl chloride	<0.0263		0.0263		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Xylenes, Total	<0.0263		0.0263		mg/Kg	✱	02/11/25 09:03	02/11/25 16:08	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	103		80 - 120				02/11/25 09:03	02/11/25 16:08	1
Dibromofluoromethane (Surr)	106		80 - 127				02/11/25 09:03	02/11/25 16:08	1
Toluene-d8 (Surr)	87		80 - 120				02/11/25 09:03	02/11/25 16:08	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Gasoline Range Organics [C6-C12]	<14.1		14.1		mg/Kg	✱	02/13/25 10:23	02/14/25 00:30	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	103		47 - 150				02/13/25 10:23	02/14/25 00:30	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	<35.3		35.3		mg/Kg	✱	02/12/25 10:18	02/14/25 03:33	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
n-Octacosane	57		12 - 150				02/12/25 10:18	02/14/25 03:33	1

General Chemistry

Analyte	Result	Qualifier	RL	RL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	19.2		0.1		%			02/08/25 11:49	1
Percent Solids (EPA Moisture)	80.8		0.1		%			02/08/25 11:49	1

Client Sample Results

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

Client Sample ID: SB-05 (10-12.5)

Lab Sample ID: 310-300055-5

Date Collected: 02/04/25 15:40

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 81.8

Method: SW846 8260D - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<0.135		0.135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Benzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Bromobenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Bromochloromethane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Bromodichloromethane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Bromoform	<0.0270		0.0270		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Bromomethane	<0.0540		0.0540		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
2-Butanone (MEK)	<0.0540		0.0540		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Carbon disulfide	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Carbon tetrachloride	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Chlorobenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Chlorodibromomethane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Chloroethane	<0.0540		0.0540		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Chloroform	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Chloromethane	<0.0540		0.0540		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
2-Chlorotoluene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
4-Chlorotoluene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
cis-1,2-Dichloroethene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
cis-1,3-Dichloropropene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,2-Dibromo-3-chloropropane	<0.0270		0.0270		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,2-Dibromoethane (EDB)	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Dibromomethane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,2-Dichlorobenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,3-Dichlorobenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,4-Dichlorobenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Dichlorodifluoromethane	<0.0405		0.0405		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,1-Dichloroethane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,2-Dichloroethane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,1-Dichloroethene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,2-Dichloropropane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,3-Dichloropropane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
2,2-Dichloropropane	<0.0540		0.0540		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,1-Dichloropropene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Ethylbenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Hexachlorobutadiene	<0.0675		0.0675		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Hexane	<0.0675		0.0675		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Isopropylbenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Methylene chloride	<0.135		0.135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Methyl tert-butyl ether	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Naphthalene	<0.0675		0.0675		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
n-Butylbenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
n-Propylbenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
p-Isopropyltoluene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
sec-Butylbenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Styrene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
tert-Butylbenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,1,1,2-Tetrachloroethane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,1,2,2-Tetrachloroethane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Tetrachloroethene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1

Eurofins Cedar Falls

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-05 (10-12.5)

Lab Sample ID: 310-300055-5

Date Collected: 02/04/25 15:40

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 81.8

Method: SW846 8260D - Volatile Organic Compounds by GC/MS (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Toluene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
trans-1,2-Dichloroethene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
trans-1,3-Dichloropropene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,2,3-Trichlorobenzene	<0.0270		0.0270		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,2,4-Trichlorobenzene	<0.0270		0.0270		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,1,1-Trichloroethane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,1,2-Trichloroethane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Trichloroethene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Trichlorofluoromethane	<0.0540		0.0540		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,2,3-Trichloropropane	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,2,4-Trimethylbenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
1,3,5-Trimethylbenzene	<0.0135		0.0135		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Vinyl chloride	<0.0270		0.0270		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Xylenes, Total	<0.0270		0.0270		mg/Kg	✳	02/11/25 09:03	02/11/25 16:32	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	106		80 - 120				02/11/25 09:03	02/11/25 16:32	1
Dibromofluoromethane (Surr)	103		80 - 127				02/11/25 09:03	02/11/25 16:32	1
Toluene-d8 (Surr)	87		80 - 120				02/11/25 09:03	02/11/25 16:32	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Gasoline Range Organics [C6-C12]	73.1		14.3		mg/Kg	✳	02/10/25 10:41	02/11/25 19:54	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	151	S1+	47 - 150				02/10/25 10:41	02/11/25 19:54	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	732		32.2		mg/Kg	✳	02/12/25 10:18	02/14/25 03:48	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
n-Octacosane	47		12 - 150				02/12/25 10:18	02/14/25 03:48	1

General Chemistry

Analyte	Result	Qualifier	RL	RL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	18.2		0.1		%			02/08/25 11:49	1
Percent Solids (EPA Moisture)	81.8		0.1		%			02/08/25 11:49	1

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-06 (7.5-10)

Lab Sample ID: 310-300055-6

Date Collected: 02/04/25 16:15

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 79.8

Method: SW846 8260D - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<0.148		0.148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Benzene	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Bromobenzene	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Bromochloromethane	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Bromodichloromethane	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Bromoform	<0.0296		0.0296		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Bromomethane	<0.0593		0.0593		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
2-Butanone (MEK)	<0.0593		0.0593		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Carbon disulfide	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Carbon tetrachloride	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Chlorobenzene	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Chlorodibromomethane	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Chloroethane	<0.0593		0.0593		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Chloroform	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Chloromethane	<0.0593		0.0593		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
2-Chlorotoluene	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
4-Chlorotoluene	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
cis-1,2-Dichloroethene	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
cis-1,3-Dichloropropene	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
1,2-Dibromo-3-chloropropane	<0.0296		0.0296		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
1,2-Dibromoethane (EDB)	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Dibromomethane	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
1,2-Dichlorobenzene	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
1,3-Dichlorobenzene	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
1,4-Dichlorobenzene	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Dichlorodifluoromethane	<0.0445		0.0445		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
1,1-Dichloroethane	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
1,2-Dichloroethane	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
1,1-Dichloroethene	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
1,2-Dichloropropane	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
1,3-Dichloropropane	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
2,2-Dichloropropane	<0.0593		0.0593		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
1,1-Dichloropropene	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Ethylbenzene	0.0221		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Hexachlorobutadiene	<0.0741		0.0741		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Hexane	<0.0741		0.0741		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Isopropylbenzene	0.0177		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Methylene chloride	<0.148		0.148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Methyl tert-butyl ether	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Naphthalene	0.422		0.0741		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
n-Butylbenzene	0.0671		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
n-Propylbenzene	0.0464		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
p-Isopropyltoluene	0.0194		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
sec-Butylbenzene	0.0205		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Styrene	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
tert-Butylbenzene	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
1,1,1,2-Tetrachloroethane	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
1,1,2,2-Tetrachloroethane	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Tetrachloroethene	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1

Eurofins Cedar Falls

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-06 (7.5-10)

Lab Sample ID: 310-300055-6

Date Collected: 02/04/25 16:15

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 79.8

Method: SW846 8260D - Volatile Organic Compounds by GC/MS (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Toluene	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
trans-1,2-Dichloroethene	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
trans-1,3-Dichloropropene	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
1,2,3-Trichlorobenzene	<0.0296		0.0296		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
1,2,4-Trichlorobenzene	<0.0296		0.0296		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
1,1,1-Trichloroethane	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
1,1,2-Trichloroethane	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Trichloroethene	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Trichlorofluoromethane	<0.0593		0.0593		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
1,2,3-Trichloropropane	<0.0148		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
1,2,4-Trimethylbenzene	0.0370		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
1,3,5-Trimethylbenzene	0.106		0.0148		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Vinyl chloride	<0.0296		0.0296		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Xylenes, Total	<0.0296		0.0296		mg/Kg	✱	02/11/25 09:03	02/11/25 16:56	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	106		80 - 120				02/11/25 09:03	02/11/25 16:56	1
Dibromofluoromethane (Surr)	100		80 - 127				02/11/25 09:03	02/11/25 16:56	1
Toluene-d8 (Surr)	86		80 - 120				02/11/25 09:03	02/11/25 16:56	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Gasoline Range Organics [C6-C12]	204		14.1		mg/Kg	✱	02/10/25 10:41	02/11/25 20:20	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	156	S1+	47 - 150				02/10/25 10:41	02/11/25 20:20	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	821		33.7		mg/Kg	✱	02/12/25 10:18	02/14/25 04:02	1
Surrogate	%Recovery	Qualifier	Limits				Prepared	Analyzed	Dil Fac
n-Octacosane	38		12 - 150				02/12/25 10:18	02/14/25 04:02	1

General Chemistry

Analyte	Result	Qualifier	RL	RL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Moisture (EPA Moisture)	20.2		0.1		%			02/08/25 11:49	1
Percent Solids (EPA Moisture)	79.8		0.1		%			02/08/25 11:49	1

Client Sample Results

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

Client Sample ID: MW-02

Lab Sample ID: 310-300055-7

Date Collected: 02/04/25 12:00

Matrix: Water

Date Received: 02/07/25 09:00

Method: SW846 8260D - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<50.0		50.0		ug/L			02/11/25 16:42	5
Benzene	8.78		2.50		ug/L			02/11/25 16:42	5
Bromobenzene	<5.00		5.00		ug/L			02/11/25 16:42	5
Bromochloromethane	<25.0		25.0		ug/L			02/11/25 16:42	5
Bromodichloromethane	<5.00		5.00		ug/L			02/11/25 16:42	5
Bromoform	<25.0		25.0		ug/L			02/11/25 16:42	5
Bromomethane	<20.0		20.0		ug/L			02/11/25 16:42	5
2-Butanone (MEK)	<50.0		50.0		ug/L			02/11/25 16:42	5
Carbon disulfide	<5.00		5.00		ug/L			02/11/25 16:42	5
Carbon tetrachloride	<10.0		10.0		ug/L			02/11/25 16:42	5
Chlorobenzene	<5.00		5.00		ug/L			02/11/25 16:42	5
Chlorodibromomethane	<25.0		25.0		ug/L			02/11/25 16:42	5
Chloroethane	<20.0		20.0		ug/L			02/11/25 16:42	5
Chloroform	<15.0		15.0		ug/L			02/11/25 16:42	5
Chloromethane	<15.0		15.0		ug/L			02/11/25 16:42	5
2-Chlorotoluene	<5.00		5.00		ug/L			02/11/25 16:42	5
4-Chlorotoluene	<5.00		5.00		ug/L			02/11/25 16:42	5
cis-1,2-Dichloroethene	<5.00		5.00		ug/L			02/11/25 16:42	5
cis-1,3-Dichloropropene	<25.0		25.0		ug/L			02/11/25 16:42	5
1,2-Dibromo-3-chloropropane	<25.0		25.0		ug/L			02/11/25 16:42	5
1,2-Dibromoethane (EDB)	<5.00		5.00		ug/L			02/11/25 16:42	5
Dibromomethane	<5.00		5.00		ug/L			02/11/25 16:42	5
1,2-Dichlorobenzene	<5.00		5.00		ug/L			02/11/25 16:42	5
1,3-Dichlorobenzene	<5.00		5.00		ug/L			02/11/25 16:42	5
1,4-Dichlorobenzene	<5.00		5.00		ug/L			02/11/25 16:42	5
Dichlorodifluoromethane	<15.0		15.0		ug/L			02/11/25 16:42	5
1,1-Dichloroethane	<5.00		5.00		ug/L			02/11/25 16:42	5
1,2-Dichloroethane	<5.00		5.00		ug/L			02/11/25 16:42	5
1,1-Dichloroethene	<10.0		10.0		ug/L			02/11/25 16:42	5
1,2-Dichloropropane	<5.00		5.00		ug/L			02/11/25 16:42	5
1,3-Dichloropropane	<5.00		5.00		ug/L			02/11/25 16:42	5
2,2-Dichloropropane	<20.0		20.0		ug/L			02/11/25 16:42	5
1,1-Dichloropropene	<5.00		5.00		ug/L			02/11/25 16:42	5
Ethylbenzene	12.9		5.00		ug/L			02/11/25 16:42	5
Hexachlorobutadiene	<25.0		25.0		ug/L			02/11/25 16:42	5
Hexane	5.58		5.00		ug/L			02/11/25 16:42	5
Isopropylbenzene	27.1		5.00		ug/L			02/11/25 16:42	5
Methylene chloride	<25.0		25.0		ug/L			02/11/25 16:42	5
Methyl tert-butyl ether	<5.00		5.00		ug/L			02/11/25 16:42	5
Naphthalene	998		25.0		ug/L			02/11/25 16:42	5
n-Butylbenzene	114		5.00		ug/L			02/11/25 16:42	5
n-Propylbenzene	46.7		5.00		ug/L			02/11/25 16:42	5
p-Isopropyltoluene	34.8		5.00		ug/L			02/11/25 16:42	5
sec-Butylbenzene	38.0		5.00		ug/L			02/11/25 16:42	5
Styrene	<5.00		5.00		ug/L			02/11/25 16:42	5
tert-Butylbenzene	<5.00		5.00		ug/L			02/11/25 16:42	5
1,1,1,2-Tetrachloroethane	<5.00		5.00		ug/L			02/11/25 16:42	5
1,1,1,2,2-Tetrachloroethane	<5.00		5.00		ug/L			02/11/25 16:42	5
Tetrachloroethene	<5.00		5.00		ug/L			02/11/25 16:42	5

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: MW-02

Lab Sample ID: 310-300055-7

Date Collected: 02/04/25 12:00

Matrix: Water

Date Received: 02/07/25 09:00

Method: SW846 8260D - Volatile Organic Compounds by GC/MS (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Toluene	<5.00		5.00		ug/L			02/11/25 16:42	5
trans-1,2-Dichloroethene	<5.00		5.00		ug/L			02/11/25 16:42	5
trans-1,3-Dichloropropene	<25.0		25.0		ug/L			02/11/25 16:42	5
1,2,3-Trichlorobenzene	<25.0		25.0		ug/L			02/11/25 16:42	5
1,2,4-Trichlorobenzene	<25.0		25.0		ug/L			02/11/25 16:42	5
1,1,1-Trichloroethane	<5.00		5.00		ug/L			02/11/25 16:42	5
1,1,2-Trichloroethane	<5.00		5.00		ug/L			02/11/25 16:42	5
Trichloroethene	<5.00		5.00		ug/L			02/11/25 16:42	5
Trichlorofluoromethane	<20.0		20.0		ug/L			02/11/25 16:42	5
1,2,3-Trichloropropane	<5.00		5.00		ug/L			02/11/25 16:42	5
1,2,4-Trimethylbenzene	129		5.00		ug/L			02/11/25 16:42	5
1,3,5-Trimethylbenzene	229		5.00		ug/L			02/11/25 16:42	5
Vinyl chloride	<5.00		5.00		ug/L			02/11/25 16:42	5
Xylenes, Total	<15.0		15.0		ug/L			02/11/25 16:42	5

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	92		80 - 120		02/11/25 16:42	5
Dibromofluoromethane (Surr)	114		73 - 130		02/11/25 16:42	5
Toluene-d8 (Surr)	98		80 - 120		02/11/25 16:42	5

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Gasoline Range Organics [C6-C12]	8100		2500		ug/L			02/11/25 13:24	5

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	98		52 - 145		02/11/25 13:24	5

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	5290000		25600		ug/L		02/10/25 14:42	02/14/25 12:23	50

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
n-Octacosane	58		32 - 144	02/10/25 14:42	02/13/25 18:51	1

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: MW-03

Lab Sample ID: 310-300055-8

Date Collected: 02/04/25 14:00

Matrix: Water

Date Received: 02/07/25 09:00

Method: SW846 8260D - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<50.0		50.0		ug/L			02/11/25 17:04	5
Benzene	<2.50		2.50		ug/L			02/11/25 17:04	5
Bromobenzene	<5.00		5.00		ug/L			02/11/25 17:04	5
Bromochloromethane	<25.0		25.0		ug/L			02/11/25 17:04	5
Bromodichloromethane	<5.00		5.00		ug/L			02/11/25 17:04	5
Bromoform	<25.0		25.0		ug/L			02/11/25 17:04	5
Bromomethane	<20.0		20.0		ug/L			02/11/25 17:04	5
2-Butanone (MEK)	<50.0		50.0		ug/L			02/11/25 17:04	5
Carbon disulfide	<5.00		5.00		ug/L			02/11/25 17:04	5
Carbon tetrachloride	<10.0		10.0		ug/L			02/11/25 17:04	5
Chlorobenzene	<5.00		5.00		ug/L			02/11/25 17:04	5
Chlorodibromomethane	<25.0		25.0		ug/L			02/11/25 17:04	5
Chloroethane	<20.0		20.0		ug/L			02/11/25 17:04	5
Chloroform	<15.0		15.0		ug/L			02/11/25 17:04	5
Chloromethane	<15.0		15.0		ug/L			02/11/25 17:04	5
2-Chlorotoluene	<5.00		5.00		ug/L			02/11/25 17:04	5
4-Chlorotoluene	<5.00		5.00		ug/L			02/11/25 17:04	5
cis-1,2-Dichloroethene	<5.00		5.00		ug/L			02/11/25 17:04	5
cis-1,3-Dichloropropene	<25.0		25.0		ug/L			02/11/25 17:04	5
1,2-Dibromo-3-chloropropane	<25.0		25.0		ug/L			02/11/25 17:04	5
1,2-Dibromoethane (EDB)	<5.00		5.00		ug/L			02/11/25 17:04	5
Dibromomethane	<5.00		5.00		ug/L			02/11/25 17:04	5
1,2-Dichlorobenzene	<5.00		5.00		ug/L			02/11/25 17:04	5
1,3-Dichlorobenzene	<5.00		5.00		ug/L			02/11/25 17:04	5
1,4-Dichlorobenzene	<5.00		5.00		ug/L			02/11/25 17:04	5
Dichlorodifluoromethane	<15.0		15.0		ug/L			02/11/25 17:04	5
1,1-Dichloroethane	<5.00		5.00		ug/L			02/11/25 17:04	5
1,2-Dichloroethane	<5.00		5.00		ug/L			02/11/25 17:04	5
1,1-Dichloroethene	<10.0		10.0		ug/L			02/11/25 17:04	5
1,2-Dichloropropane	<5.00		5.00		ug/L			02/11/25 17:04	5
1,3-Dichloropropane	<5.00		5.00		ug/L			02/11/25 17:04	5
2,2-Dichloropropane	<20.0		20.0		ug/L			02/11/25 17:04	5
1,1-Dichloropropene	<5.00		5.00		ug/L			02/11/25 17:04	5
Ethylbenzene	<5.00		5.00		ug/L			02/11/25 17:04	5
Hexachlorobutadiene	<25.0		25.0		ug/L			02/11/25 17:04	5
Hexane	<5.00		5.00		ug/L			02/11/25 17:04	5
Isopropylbenzene	<5.00		5.00		ug/L			02/11/25 17:04	5
Methylene chloride	<25.0		25.0		ug/L			02/11/25 17:04	5
Methyl tert-butyl ether	<5.00		5.00		ug/L			02/11/25 17:04	5
Naphthalene	<25.0		25.0		ug/L			02/11/25 17:04	5
n-Butylbenzene	9.39		5.00		ug/L			02/11/25 17:04	5
n-Propylbenzene	7.54		5.00		ug/L			02/11/25 17:04	5
p-Isopropyltoluene	<5.00		5.00		ug/L			02/11/25 17:04	5
sec-Butylbenzene	<5.00		5.00		ug/L			02/11/25 17:04	5
Styrene	<5.00		5.00		ug/L			02/11/25 17:04	5
tert-Butylbenzene	<5.00		5.00		ug/L			02/11/25 17:04	5
1,1,1,2-Tetrachloroethane	<5.00		5.00		ug/L			02/11/25 17:04	5
1,1,2,2-Tetrachloroethane	<5.00		5.00		ug/L			02/11/25 17:04	5
Tetrachloroethene	<5.00		5.00		ug/L			02/11/25 17:04	5

Eurofins Cedar Falls

Client Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: MW-03

Lab Sample ID: 310-300055-8

Date Collected: 02/04/25 14:00

Matrix: Water

Date Received: 02/07/25 09:00

Method: SW846 8260D - Volatile Organic Compounds by GC/MS (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Toluene	<5.00		5.00		ug/L			02/11/25 17:04	5
trans-1,2-Dichloroethene	<5.00		5.00		ug/L			02/11/25 17:04	5
trans-1,3-Dichloropropene	<25.0		25.0		ug/L			02/11/25 17:04	5
1,2,3-Trichlorobenzene	<25.0		25.0		ug/L			02/11/25 17:04	5
1,2,4-Trichlorobenzene	<25.0		25.0		ug/L			02/11/25 17:04	5
1,1,1-Trichloroethane	<5.00		5.00		ug/L			02/11/25 17:04	5
1,1,2-Trichloroethane	<5.00		5.00		ug/L			02/11/25 17:04	5
Trichloroethene	<5.00		5.00		ug/L			02/11/25 17:04	5
Trichlorofluoromethane	<20.0		20.0		ug/L			02/11/25 17:04	5
1,2,3-Trichloropropane	<5.00		5.00		ug/L			02/11/25 17:04	5
1,2,4-Trimethylbenzene	7.98		5.00		ug/L			02/11/25 17:04	5
1,3,5-Trimethylbenzene	32.9		5.00		ug/L			02/11/25 17:04	5
Vinyl chloride	<5.00		5.00		ug/L			02/11/25 17:04	5
Xylenes, Total	<15.0		15.0		ug/L			02/11/25 17:04	5

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	102		80 - 120		02/11/25 17:04	5
Dibromofluoromethane (Surr)	106		73 - 130		02/11/25 17:04	5
Toluene-d8 (Surr)	97		80 - 120		02/11/25 17:04	5

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Gasoline Range Organics [C6-C12]	<2500		2500		ug/L			02/11/25 13:53	5

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	98		52 - 145		02/11/25 13:53	5

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	964		341		ug/L		02/10/25 14:42	02/13/25 18:37	1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
n-Octacosane	80		32 - 144	02/10/25 14:42	02/13/25 18:37	1

Client Sample Results

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

Client Sample ID: HCL Blank

Lab Sample ID: 310-300055-9

Date Collected: 02/04/25 00:00

Matrix: Water

Date Received: 02/07/25 09:00

Method: SW846 8260D - Volatile Organic Compounds by GC/MS

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<10.0		10.0		ug/L			02/11/25 11:27	1
Benzene	<0.500		0.500		ug/L			02/11/25 11:27	1
Bromobenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
Bromochloromethane	<5.00		5.00		ug/L			02/11/25 11:27	1
Bromodichloromethane	<1.00		1.00		ug/L			02/11/25 11:27	1
Bromoform	<5.00		5.00		ug/L			02/11/25 11:27	1
Bromomethane	<4.00		4.00		ug/L			02/11/25 11:27	1
2-Butanone (MEK)	<10.0		10.0		ug/L			02/11/25 11:27	1
Carbon disulfide	<1.00		1.00		ug/L			02/11/25 11:27	1
Carbon tetrachloride	<2.00		2.00		ug/L			02/11/25 11:27	1
Chlorobenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
Chlorodibromomethane	<5.00		5.00		ug/L			02/11/25 11:27	1
Chloroethane	<4.00		4.00		ug/L			02/11/25 11:27	1
Chloroform	<3.00		3.00		ug/L			02/11/25 11:27	1
Chloromethane	<3.00		3.00		ug/L			02/11/25 11:27	1
2-Chlorotoluene	<1.00		1.00		ug/L			02/11/25 11:27	1
4-Chlorotoluene	<1.00		1.00		ug/L			02/11/25 11:27	1
cis-1,2-Dichloroethene	<1.00		1.00		ug/L			02/11/25 11:27	1
cis-1,3-Dichloropropene	<5.00		5.00		ug/L			02/11/25 11:27	1
1,2-Dibromo-3-chloropropane	<5.00		5.00		ug/L			02/11/25 11:27	1
1,2-Dibromoethane (EDB)	<1.00		1.00		ug/L			02/11/25 11:27	1
Dibromomethane	<1.00		1.00		ug/L			02/11/25 11:27	1
1,2-Dichlorobenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
1,3-Dichlorobenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
1,4-Dichlorobenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
Dichlorodifluoromethane	<3.00		3.00		ug/L			02/11/25 11:27	1
1,1-Dichloroethane	<1.00		1.00		ug/L			02/11/25 11:27	1
1,2-Dichloroethane	<1.00		1.00		ug/L			02/11/25 11:27	1
1,1-Dichloroethene	<2.00		2.00		ug/L			02/11/25 11:27	1
1,2-Dichloropropane	<1.00		1.00		ug/L			02/11/25 11:27	1
1,3-Dichloropropane	<1.00		1.00		ug/L			02/11/25 11:27	1
2,2-Dichloropropane	<4.00		4.00		ug/L			02/11/25 11:27	1
1,1-Dichloropropene	<1.00		1.00		ug/L			02/11/25 11:27	1
Ethylbenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
Hexachlorobutadiene	<5.00		5.00		ug/L			02/11/25 11:27	1
Hexane	<1.00		1.00		ug/L			02/11/25 11:27	1
Isopropylbenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
Methylene chloride	<5.00		5.00		ug/L			02/11/25 11:27	1
Methyl tert-butyl ether	<1.00		1.00		ug/L			02/11/25 11:27	1
Naphthalene	<5.00		5.00		ug/L			02/11/25 11:27	1
n-Butylbenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
n-Propylbenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
p-Isopropyltoluene	<1.00		1.00		ug/L			02/11/25 11:27	1
sec-Butylbenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
Styrene	<1.00		1.00		ug/L			02/11/25 11:27	1
tert-Butylbenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
1,1,1,2-Tetrachloroethane	<1.00		1.00		ug/L			02/11/25 11:27	1
1,1,2,2-Tetrachloroethane	<1.00		1.00		ug/L			02/11/25 11:27	1
Tetrachloroethene	<1.00		1.00		ug/L			02/11/25 11:27	1

Eurofins Cedar Falls

Client Sample Results

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

Client Sample ID: HCL Blank

Lab Sample ID: 310-300055-9

Date Collected: 02/04/25 00:00

Matrix: Water

Date Received: 02/07/25 09:00

Method: SW846 8260D - Volatile Organic Compounds by GC/MS (Continued)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Toluene	<1.00		1.00		ug/L			02/11/25 11:27	1
trans-1,2-Dichloroethene	<1.00		1.00		ug/L			02/11/25 11:27	1
trans-1,3-Dichloropropene	<5.00		5.00		ug/L			02/11/25 11:27	1
1,2,3-Trichlorobenzene	<5.00		5.00		ug/L			02/11/25 11:27	1
1,2,4-Trichlorobenzene	<5.00		5.00		ug/L			02/11/25 11:27	1
1,1,1-Trichloroethane	<1.00		1.00		ug/L			02/11/25 11:27	1
1,1,2-Trichloroethane	<1.00		1.00		ug/L			02/11/25 11:27	1
Trichloroethene	<1.00		1.00		ug/L			02/11/25 11:27	1
Trichlorofluoromethane	<4.00		4.00		ug/L			02/11/25 11:27	1
1,2,3-Trichloropropane	<1.00		1.00		ug/L			02/11/25 11:27	1
1,2,4-Trimethylbenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
1,3,5-Trimethylbenzene	<1.00		1.00		ug/L			02/11/25 11:27	1
Vinyl chloride	<1.00		1.00		ug/L			02/11/25 11:27	1
Xylenes, Total	<3.00		3.00		ug/L			02/11/25 11:27	1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	102		80 - 120		02/11/25 11:27	1
Dibromofluoromethane (Surr)	104		73 - 130		02/11/25 11:27	1
Toluene-d8 (Surr)	95		80 - 120		02/11/25 11:27	1

Method: SW846 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Gasoline Range Organics [C6-C12]	<500		500		ug/L			02/11/25 05:12	1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	102		52 - 145		02/11/25 05:12	1

Definitions/Glossary

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Qualifiers

GC/MS VOA

Qualifier	Qualifier Description
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

GC VOA

Qualifier	Qualifier Description
S1+	Surrogate recovery exceeds control limits, high biased.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
☼	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

Surrogate Summary

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS

Matrix: Solid

Prep Type: Total/NA

Lab Sample ID	Client Sample ID	Percent Surrogate Recovery (Acceptance Limits)		
		BFB (80-120)	DBFM (80-120)	TOL (80-120)
310-300055-1	SB-01 (10-12.5)	101	107	86
310-300055-3	SB-03 (7.5-10)	91	100	85
310-300055-3	SB-03 (7.5-10)	86	98	94
310-300055-4	SB-04 (12.5-15)	103	106	87
310-300055-5	SB-05 (10-12.5)	106	103	87
310-300055-6	SB-06 (7.5-10)	106	100	86
LCS 310-446661/2-A	Lab Control Sample	105	101	91
LCS 310-446664/2-A	Lab Control Sample	109	102	93
LCS 310-446943/2-A	Lab Control Sample	101	98	101
MB 310-446661/1-A	Method Blank	98	106	86
MB 310-446664/1-A	Method Blank	106	102	90
MB 310-446943/1-A	Method Blank	93	102	97

Surrogate Legend

BFB = 4-Bromofluorobenzene (Surr)
DBFM = Dibromofluoromethane (Surr)
TOL = Toluene-d8 (Surr)

Method: 8260D - Volatile Organic Compounds by GC/MS

Matrix: Solid

Prep Type: Total/NA

Lab Sample ID	Client Sample ID	Percent Surrogate Recovery (Acceptance Limits)		
		BFB (80-120)	DBFM (80-120)	TOL (80-120)
310-300055-2	SB-02 (17.5-20)	97	108	100
LCS 310-446784/2-A	Lab Control Sample	104	102	96
MB 310-446784/1-A	Method Blank	104	108	102

Surrogate Legend

BFB = 4-Bromofluorobenzene (Surr)
DBFM = Dibromofluoromethane (Surr)
TOL = Toluene-d8 (Surr)

Method: 8260D - Volatile Organic Compounds by GC/MS

Matrix: Water

Prep Type: Total/NA

Lab Sample ID	Client Sample ID	Percent Surrogate Recovery (Acceptance Limits)		
		BFB (80-120)	DBFM (73-130)	TOL (80-120)
310-300055-7	MW-02	92	114	98
310-300055-8	MW-03	102	106	97
310-300055-9	HCL Blank	102	104	95
LCS 310-446646/6	Lab Control Sample	100	95	101
LCS 310-446646/7	Lab Control Sample	107	106	94
MB 310-446646/5	Method Blank	108	102	95

Surrogate Legend

BFB = 4-Bromofluorobenzene (Surr)
DBFM = Dibromofluoromethane (Surr)
TOL = Toluene-d8 (Surr)

Eurofins Cedar Falls

Surrogate Summary

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

Method: 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Matrix: Solid

Prep Type: Total/NA

Percent Surrogate Recovery (Acceptance Limits)		
Lab Sample ID	Client Sample ID	BFB1 (47-150)
310-300055-1	SB-01 (10-12.5)	100
310-300055-2	SB-02 (17.5-20)	122
310-300055-3	SB-03 (7.5-10)	161 S1+
310-300055-4	SB-04 (12.5-15)	103
310-300055-5	SB-05 (10-12.5)	151 S1+
310-300055-6	SB-06 (7.5-10)	156 S1+
LCS 310-446574/2-A	Lab Control Sample	278 S1+
LCS 310-446819/2-A	Lab Control Sample	271 S1+
MB 310-446574/1-A	Method Blank	99
MB 310-446819/1-A	Method Blank	105
Surrogate Legend		
BFB = 4-Bromofluorobenzene (Surr)		

Method: 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Matrix: Water

Prep Type: Total/NA

Percent Surrogate Recovery (Acceptance Limits)		
Lab Sample ID	Client Sample ID	BFB1 (52-145)
310-300055-7	MW-02	98
310-300055-8	MW-03	98
310-300055-9	HCL Blank	102
LCS 310-446613/4	Lab Control Sample	166 S1+
MB 310-446613/5	Method Blank	105
Surrogate Legend		
BFB = 4-Bromofluorobenzene (Surr)		

Method: 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Matrix: Solid

Prep Type: Total/NA

Percent Surrogate Recovery (Acceptance Limits)		
Lab Sample ID	Client Sample ID	OTCN1 (12-150)
310-300055-1	SB-01 (10-12.5)	42
310-300055-2	SB-02 (17.5-20)	74
310-300055-3	SB-03 (7.5-10)	59
310-300055-4	SB-04 (12.5-15)	57
310-300055-5	SB-05 (10-12.5)	47
310-300055-6	SB-06 (7.5-10)	38
LCS 310-446752/2-A	Lab Control Sample	107
LCS 310-446980/2-A	Lab Control Sample	89
MB 310-446752/1-A	Method Blank	101
MB 310-446980/1-A	Method Blank	91
Surrogate Legend		
OTCN = n-Octacosane		

Surrogate Summary

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Matrix: Water

Prep Type: Total/NA

Percent Surrogate Recovery (Acceptance Limits)

Lab Sample ID	Client Sample ID	OTCN1 (32-144)
310-300055-7	MW-02	58
310-300055-8	MW-03	80
LCS 310-446619/2-A	Lab Control Sample	80
LCSD 310-446619/3-A	Lab Control Sample Dup	68
MB 310-446619/1-A	Method Blank	112

Surrogate Legend

OTCN = n-Octacosane

QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS

Lab Sample ID: MB 310-446646/5
Matrix: Water
Analysis Batch: 446646

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB	MB	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
Acetone	<10.0		10.0		ug/L			02/11/25 09:33	1
Benzene	<0.500		0.500		ug/L			02/11/25 09:33	1
Bromobenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
Bromochloromethane	<5.00		5.00		ug/L			02/11/25 09:33	1
Bromodichloromethane	<1.00		1.00		ug/L			02/11/25 09:33	1
Bromoform	<5.00		5.00		ug/L			02/11/25 09:33	1
Bromomethane	<4.00		4.00		ug/L			02/11/25 09:33	1
2-Butanone (MEK)	<10.0		10.0		ug/L			02/11/25 09:33	1
Carbon disulfide	<1.00		1.00		ug/L			02/11/25 09:33	1
Carbon tetrachloride	<2.00		2.00		ug/L			02/11/25 09:33	1
Chlorobenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
Chlorodibromomethane	<5.00		5.00		ug/L			02/11/25 09:33	1
Chloroethane	<4.00		4.00		ug/L			02/11/25 09:33	1
Chloroform	<3.00		3.00		ug/L			02/11/25 09:33	1
Chloromethane	<3.00		3.00		ug/L			02/11/25 09:33	1
2-Chlorotoluene	<1.00		1.00		ug/L			02/11/25 09:33	1
4-Chlorotoluene	<1.00		1.00		ug/L			02/11/25 09:33	1
cis-1,2-Dichloroethene	<1.00		1.00		ug/L			02/11/25 09:33	1
cis-1,3-Dichloropropene	<5.00		5.00		ug/L			02/11/25 09:33	1
1,2-Dibromo-3-chloropropane	<5.00		5.00		ug/L			02/11/25 09:33	1
1,2-Dibromoethane (EDB)	<1.00		1.00		ug/L			02/11/25 09:33	1
Dibromomethane	<1.00		1.00		ug/L			02/11/25 09:33	1
1,2-Dichlorobenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
1,3-Dichlorobenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
1,4-Dichlorobenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
Dichlorodifluoromethane	<3.00		3.00		ug/L			02/11/25 09:33	1
1,1-Dichloroethane	<1.00		1.00		ug/L			02/11/25 09:33	1
1,2-Dichloroethane	<1.00		1.00		ug/L			02/11/25 09:33	1
1,1-Dichloroethene	<2.00		2.00		ug/L			02/11/25 09:33	1
1,2-Dichloropropane	<1.00		1.00		ug/L			02/11/25 09:33	1
1,3-Dichloropropane	<1.00		1.00		ug/L			02/11/25 09:33	1
2,2-Dichloropropane	<4.00		4.00		ug/L			02/11/25 09:33	1
1,1-Dichloropropene	<1.00		1.00		ug/L			02/11/25 09:33	1
Ethylbenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
Hexachlorobutadiene	<5.00		5.00		ug/L			02/11/25 09:33	1
Hexane	<1.00		1.00		ug/L			02/11/25 09:33	1
Isopropylbenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
Methylene chloride	<5.00		5.00		ug/L			02/11/25 09:33	1
Methyl tert-butyl ether	<1.00		1.00		ug/L			02/11/25 09:33	1
Naphthalene	<5.00		5.00		ug/L			02/11/25 09:33	1
n-Butylbenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
n-Propylbenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
p-Isopropyltoluene	<1.00		1.00		ug/L			02/11/25 09:33	1
sec-Butylbenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
Styrene	<1.00		1.00		ug/L			02/11/25 09:33	1
tert-Butylbenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
1,1,1,2-Tetrachloroethane	<1.00		1.00		ug/L			02/11/25 09:33	1
1,1,2,2-Tetrachloroethane	<1.00		1.00		ug/L			02/11/25 09:33	1

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QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: MB 310-446646/5

Client Sample ID: Method Blank

Matrix: Water

Prep Type: Total/NA

Analysis Batch: 446646

Analyte	MB	MB	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
Tetrachloroethene	<1.00		1.00		ug/L			02/11/25 09:33	1
Toluene	<1.00		1.00		ug/L			02/11/25 09:33	1
trans-1,2-Dichloroethene	<1.00		1.00		ug/L			02/11/25 09:33	1
trans-1,3-Dichloropropene	<5.00		5.00		ug/L			02/11/25 09:33	1
1,2,3-Trichlorobenzene	<5.00		5.00		ug/L			02/11/25 09:33	1
1,2,4-Trichlorobenzene	<5.00		5.00		ug/L			02/11/25 09:33	1
1,1,1-Trichloroethane	<1.00		1.00		ug/L			02/11/25 09:33	1
1,1,2-Trichloroethane	<1.00		1.00		ug/L			02/11/25 09:33	1
Trichloroethene	<1.00		1.00		ug/L			02/11/25 09:33	1
Trichlorofluoromethane	<4.00		4.00		ug/L			02/11/25 09:33	1
1,2,3-Trichloropropane	<1.00		1.00		ug/L			02/11/25 09:33	1
1,2,4-Trimethylbenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
1,3,5-Trimethylbenzene	<1.00		1.00		ug/L			02/11/25 09:33	1
Vinyl chloride	<1.00		1.00		ug/L			02/11/25 09:33	1
Xylenes, Total	<3.00		3.00		ug/L			02/11/25 09:33	1

Surrogate	MB	MB	Limits	Prepared	Analyzed	Dil Fac
	%Recovery	Qualifier				
4-Bromofluorobenzene (Surr)	108		80 - 120		02/11/25 09:33	1
Dibromofluoromethane (Surr)	102		73 - 130		02/11/25 09:33	1
Toluene-d8 (Surr)	95		80 - 120		02/11/25 09:33	1

Lab Sample ID: LCS 310-446646/6

Client Sample ID: Lab Control Sample

Matrix: Water

Prep Type: Total/NA

Analysis Batch: 446646

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Benzene	20.0	19.51		ug/L		98	72 - 124
Bromobenzene	20.0	19.55		ug/L		98	72 - 120
Bromochloromethane	20.0	18.61		ug/L		93	73 - 130
Bromodichloromethane	20.0	17.90		ug/L		89	74 - 122
Bromoform	20.0	19.46		ug/L		97	61 - 122
2-Butanone (MEK)	40.0	36.56		ug/L		91	50 - 150
Carbon disulfide	20.0	19.44		ug/L		97	59 - 135
Carbon tetrachloride	20.0	17.92		ug/L		90	67 - 132
Chlorobenzene	20.0	17.46		ug/L		87	76 - 120
Chlorodibromomethane	20.0	17.59		ug/L		88	71 - 121
Chloroform	20.0	19.04		ug/L		95	72 - 125
2-Chlorotoluene	20.0	20.23		ug/L		101	73 - 121
4-Chlorotoluene	20.0	19.41		ug/L		97	72 - 121
cis-1,2-Dichloroethene	20.0	19.17		ug/L		96	74 - 123
cis-1,3-Dichloropropene	20.0	19.98		ug/L		100	71 - 125
1,2-Dibromo-3-chloropropane	20.0	18.62		ug/L		93	50 - 150
1,2-Dibromoethane (EDB)	20.0	18.47		ug/L		92	75 - 125
Dibromomethane	20.0	19.34		ug/L		97	74 - 125
1,2-Dichlorobenzene	20.0	19.67		ug/L		98	74 - 120
1,3-Dichlorobenzene	20.0	18.90		ug/L		94	72 - 120
1,4-Dichlorobenzene	20.0	18.72		ug/L		94	72 - 120

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QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: LCS 310-446646/6

Matrix: Water

Analysis Batch: 446646

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
1,1-Dichloroethane	20.0	20.09		ug/L		100	70 - 127
1,2-Dichloroethane	20.0	20.05		ug/L		100	71 - 125
1,1-Dichloroethene	20.0	18.48		ug/L		92	63 - 132
1,2-Dichloropropane	20.0	18.83		ug/L		94	73 - 124
1,3-Dichloropropane	20.0	18.50		ug/L		92	72 - 125
2,2-Dichloropropane	20.0	19.07		ug/L		95	50 - 150
1,1-Dichloropropene	20.0	18.91		ug/L		95	69 - 132
Ethylbenzene	20.0	18.75		ug/L		94	74 - 122
Hexachlorobutadiene	20.0	19.63		ug/L		98	50 - 150
Hexane	20.0	20.73		ug/L		104	45 - 150
Isopropylbenzene	20.0	20.26		ug/L		101	73 - 125
Methylene chloride	20.0	20.20		ug/L		101	50 - 150
Methyl tert-butyl ether	20.0	19.11		ug/L		96	68 - 130
Naphthalene	20.0	20.60		ug/L		103	50 - 150
n-Butylbenzene	20.0	21.37		ug/L		107	67 - 131
n-Propylbenzene	20.0	21.19		ug/L		106	72 - 126
p-Isopropyltoluene	20.0	19.71		ug/L		99	70 - 127
sec-Butylbenzene	20.0	20.78		ug/L		104	70 - 127
Styrene	20.0	19.96		ug/L		100	74 - 121
tert-Butylbenzene	20.0	20.68		ug/L		103	72 - 124
1,1,1,2-Tetrachloroethane	20.0	18.61		ug/L		93	71 - 120
1,1,2,2-Tetrachloroethane	20.0	18.88		ug/L		94	68 - 124
Tetrachloroethene	20.0	18.15		ug/L		91	71 - 130
Toluene	20.0	18.81		ug/L		94	74 - 123
trans-1,2-Dichloroethene	20.0	18.10		ug/L		91	70 - 126
trans-1,3-Dichloropropene	20.0	17.93		ug/L		90	69 - 123
1,2,3-Trichlorobenzene	20.0	19.03		ug/L		95	50 - 150
1,2,4-Trichlorobenzene	20.0	19.45		ug/L		97	68 - 124
1,1,1-Trichloroethane	20.0	18.45		ug/L		92	73 - 129
1,1,2-Trichloroethane	20.0	18.05		ug/L		90	73 - 123
Trichloroethene	20.0	17.83		ug/L		89	72 - 126
1,2,3-Trichloropropane	20.0	18.94		ug/L		95	65 - 127
1,2,4-Trimethylbenzene	20.0	18.59		ug/L		93	73 - 124
1,3,5-Trimethylbenzene	20.0	20.13		ug/L		101	73 - 123
Xylenes, Total	40.0	40.14		ug/L		100	73 - 123

Surrogate	LCS %Recovery	LCS Qualifier	Limits
4-Bromofluorobenzene (Surr)	100		80 - 120
Dibromofluoromethane (Surr)	95		73 - 130
Toluene-d8 (Surr)	101		80 - 120

Lab Sample ID: LCS 310-446646/7

Matrix: Water

Analysis Batch: 446646

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Bromomethane	20.0	16.14		ug/L		81	23 - 150
Chloroethane	20.0	19.03		ug/L		95	54 - 136

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QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: LCS 310-446646/7

Matrix: Water

Analysis Batch: 446646

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike	LCS	LCS	Unit	D	%Rec	%Rec Limits
	Added	Result	Qualifier				
Chloromethane	20.0	21.26		ug/L		106	38 - 150
Dichlorodifluoromethane	20.0	18.53		ug/L		93	39 - 150
Trichlorofluoromethane	20.0	17.97		ug/L		90	54 - 149
Vinyl chloride	20.0	19.77		ug/L		99	56 - 140

Surrogate	LCS	LCS	Limits
	%Recovery	Qualifier	
4-Bromofluorobenzene (Surr)	107		80 - 120
Dibromofluoromethane (Surr)	106		73 - 130
Toluene-d8 (Surr)	94		80 - 120

Lab Sample ID: MB 310-446661/1-A

Matrix: Solid

Analysis Batch: 446663

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 446661

Analyte	MB	MB	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
Acetone	<0.101		0.101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Benzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Bromobenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Bromochloromethane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Bromodichloromethane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Bromoform	<0.0202		0.0202		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Bromomethane	<0.0403		0.0403		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
2-Butanone (MEK)	<0.0403		0.0403		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Carbon disulfide	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Carbon tetrachloride	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Chlorobenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Chlorodibromomethane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Chloroethane	<0.0403		0.0403		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Chloroform	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Chloromethane	<0.0403		0.0403		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
2-Chlorotoluene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
4-Chlorotoluene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
cis-1,2-Dichloroethene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
cis-1,3-Dichloropropene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,2-Dibromo-3-chloropropane	<0.0202		0.0202		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,2-Dibromoethane (EDB)	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Dibromomethane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,2-Dichlorobenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,3-Dichlorobenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,4-Dichlorobenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Dichlorodifluoromethane	<0.0302		0.0302		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,1-Dichloroethane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,2-Dichloroethane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,1-Dichloroethene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,2-Dichloropropane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,3-Dichloropropane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
2,2-Dichloropropane	<0.0403		0.0403		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,1-Dichloropropene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1

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QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: MB 310-446661/1-A
Matrix: Solid
Analysis Batch: 446663

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 446661

Analyte	MB	MB	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
Ethylbenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Hexachlorobutadiene	<0.0504		0.0504		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Hexane	<0.0504		0.0504		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Isopropylbenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Methylene chloride	<0.101		0.101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Methyl tert-butyl ether	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Naphthalene	<0.0504		0.0504		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
n-Butylbenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
n-Propylbenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
p-Isopropyltoluene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
sec-Butylbenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Styrene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
tert-Butylbenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,1,1,2-Tetrachloroethane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,1,2,2-Tetrachloroethane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Tetrachloroethene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Toluene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
trans-1,2-Dichloroethene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
trans-1,3-Dichloropropene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,2,3-Trichlorobenzene	<0.0202		0.0202		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,2,4-Trichlorobenzene	<0.0202		0.0202		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,1,1-Trichloroethane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,1,2-Trichloroethane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Trichloroethene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Trichlorofluoromethane	<0.0403		0.0403		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,2,3-Trichloropropane	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,2,4-Trimethylbenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
1,3,5-Trimethylbenzene	<0.0101		0.0101		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Vinyl chloride	<0.0202		0.0202		mg/Kg		02/11/25 09:03	02/11/25 11:44	1
Xylenes, Total	<0.0202		0.0202		mg/Kg		02/11/25 09:03	02/11/25 11:44	1

Surrogate	MB	MB	Limits	Prepared	Analyzed	Dil Fac
	%Recovery	Qualifier				
4-Bromofluorobenzene (Surr)	98		80 - 120	02/11/25 09:03	02/11/25 11:44	1
Dibromofluoromethane (Surr)	106		80 - 127	02/11/25 09:03	02/11/25 11:44	1
Toluene-d8 (Surr)	86		80 - 120	02/11/25 09:03	02/11/25 11:44	1

Lab Sample ID: LCS 310-446661/2-A
Matrix: Solid
Analysis Batch: 446663

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 446661

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Benzene	0.0851	0.08649		mg/Kg		102	75 - 137
Bromobenzene	0.0851	0.07684		mg/Kg		90	72 - 126
Bromochloromethane	0.0851	0.08365		mg/Kg		98	74 - 142
Bromodichloromethane	0.0851	0.07314		mg/Kg		86	73 - 127
Bromoform	0.0851	0.08174		mg/Kg		96	75 - 131
2-Butanone (MEK)	0.170	0.2169		mg/Kg		127	50 - 150

Eurofins Cedar Falls

QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: LCS 310-446661/2-A

Matrix: Solid

Analysis Batch: 446663

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 446661

Analyte	Spike	LCS	LCS	Unit	D	%Rec	%Rec Limits
	Added	Result	Qualifier				
Carbon disulfide	0.0851	0.07444		mg/Kg		87	53 - 150
Carbon tetrachloride	0.0851	0.08157		mg/Kg		96	71 - 138
Chlorobenzene	0.0851	0.07383		mg/Kg		87	71 - 124
Chlorodibromomethane	0.0851	0.07895		mg/Kg		93	76 - 130
Chloroform	0.0851	0.07989		mg/Kg		94	71 - 132
2-Chlorotoluene	0.0851	0.07365		mg/Kg		87	70 - 124
4-Chlorotoluene	0.0851	0.07620		mg/Kg		89	64 - 126
cis-1,2-Dichloroethene	0.0851	0.08259		mg/Kg		97	74 - 138
cis-1,3-Dichloropropene	0.0851	0.07603		mg/Kg		89	76 - 132
1,2-Dibromo-3-chloropropane	0.0851	0.07608		mg/Kg		89	50 - 150
1,2-Dibromoethane (EDB)	0.0851	0.08084		mg/Kg		95	78 - 131
Dibromomethane	0.0851	0.09161		mg/Kg		108	75 - 139
1,2-Dichlorobenzene	0.0851	0.06948		mg/Kg		82	71 - 124
1,3-Dichlorobenzene	0.0851	0.06762		mg/Kg		79	67 - 124
1,4-Dichlorobenzene	0.0851	0.06710		mg/Kg		79	65 - 124
1,1-Dichloroethane	0.0851	0.08220		mg/Kg		97	71 - 142
1,2-Dichloroethane	0.0851	0.08772		mg/Kg		103	72 - 138
1,1-Dichloroethene	0.0851	0.07532		mg/Kg		88	59 - 150
1,2-Dichloropropane	0.0851	0.08699		mg/Kg		102	74 - 139
1,3-Dichloropropane	0.0851	0.09360		mg/Kg		110	74 - 143
2,2-Dichloropropane	0.0851	0.08279		mg/Kg		97	50 - 150
1,1-Dichloropropene	0.0851	0.08306		mg/Kg		98	72 - 137
Ethylbenzene	0.0851	0.07401		mg/Kg		87	73 - 126
Hexachlorobutadiene	0.0851	0.05914		mg/Kg		69	50 - 150
Hexane	0.0851	0.06588		mg/Kg		77	41 - 150
Isopropylbenzene	0.0851	0.07641		mg/Kg		90	73 - 126
Methylene chloride	0.0851	0.07787	J	mg/Kg		91	50 - 150
Methyl tert-butyl ether	0.0851	0.08595		mg/Kg		101	71 - 144
Naphthalene	0.0851	0.07363		mg/Kg		86	50 - 150
n-Butylbenzene	0.0851	0.06473		mg/Kg		76	59 - 128
n-Propylbenzene	0.0851	0.07457		mg/Kg		88	69 - 127
p-Isopropyltoluene	0.0851	0.06790		mg/Kg		80	66 - 125
sec-Butylbenzene	0.0851	0.06794		mg/Kg		80	71 - 124
Styrene	0.0851	0.07967		mg/Kg		94	73 - 124
tert-Butylbenzene	0.0851	0.06974		mg/Kg		82	74 - 126
1,1,1,2-Tetrachloroethane	0.0851	0.07760		mg/Kg		91	75 - 129
1,1,1,2,2-Tetrachloroethane	0.0851	0.08084		mg/Kg		95	74 - 134
Tetrachloroethene	0.0851	0.07122		mg/Kg		84	66 - 127
Toluene	0.0851	0.07279		mg/Kg		85	72 - 126
trans-1,2-Dichloroethene	0.0851	0.07636		mg/Kg		90	69 - 139
trans-1,3-Dichloropropene	0.0851	0.07823		mg/Kg		92	74 - 134
1,2,3-Trichlorobenzene	0.0851	0.06764		mg/Kg		79	50 - 150
1,2,4-Trichlorobenzene	0.0851	0.06553		mg/Kg		77	49 - 135
1,1,1-Trichloroethane	0.0851	0.08311		mg/Kg		98	75 - 136
1,1,2-Trichloroethane	0.0851	0.07765		mg/Kg		91	75 - 134
Trichloroethene	0.0851	0.08519		mg/Kg		100	73 - 134
1,2,3-Trichloropropane	0.0851	0.08085		mg/Kg		95	74 - 131
1,2,4-Trimethylbenzene	0.0851	0.06760		mg/Kg		79	66 - 128
1,3,5-Trimethylbenzene	0.0851	0.06865		mg/Kg		81	69 - 124

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QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: LCS 310-446661/2-A

Matrix: Solid

Analysis Batch: 446663

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 446661

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Xylenes, Total	0.170	0.1504		mg/Kg		88	70 - 129

Surrogate	LCS %Recovery	LCS Qualifier	Limits
4-Bromofluorobenzene (Surr)	105		80 - 120
Dibromofluoromethane (Surr)	101		80 - 127
Toluene-d8 (Surr)	91		80 - 120

Lab Sample ID: MB 310-446664/1-A

Matrix: Solid

Analysis Batch: 446665

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 446664

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	<0.103		0.103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Benzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Bromobenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Bromochloromethane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Bromodichloromethane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Bromoform	<0.0206		0.0206		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Bromomethane	<0.0412		0.0412		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
2-Butanone (MEK)	<0.0412		0.0412		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Carbon disulfide	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Carbon tetrachloride	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Chlorobenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Chlorodibromomethane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Chloroethane	<0.0412		0.0412		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Chloroform	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Chloromethane	<0.0412		0.0412		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
2-Chlorotoluene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
4-Chlorotoluene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
cis-1,2-Dichloroethene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
cis-1,3-Dichloropropene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,2-Dibromo-3-chloropropane	<0.0206		0.0206		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,2-Dibromoethane (EDB)	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Dibromomethane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,2-Dichlorobenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,3-Dichlorobenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,4-Dichlorobenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Dichlorodifluoromethane	<0.0309		0.0309		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,1-Dichloroethane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,2-Dichloroethane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,1-Dichloroethene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,2-Dichloropropane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,3-Dichloropropane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
2,2-Dichloropropane	<0.0412		0.0412		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,1-Dichloropropene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Ethylbenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Hexachlorobutadiene	<0.0515		0.0515		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Hexane	<0.0515		0.0515		mg/Kg		02/11/25 09:08	02/11/25 22:57	1

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QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: MB 310-446664/1-A

Matrix: Solid

Analysis Batch: 446665

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 446664

Analyte	MB	MB	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
Isopropylbenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Methylene chloride	<0.103		0.103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Methyl tert-butyl ether	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Naphthalene	<0.0515		0.0515		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
n-Butylbenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
n-Propylbenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
p-Isopropyltoluene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
sec-Butylbenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Styrene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
tert-Butylbenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,1,1,2-Tetrachloroethane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,1,2,2-Tetrachloroethane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Tetrachloroethene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Toluene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
trans-1,2-Dichloroethene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
trans-1,3-Dichloropropene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,2,3-Trichlorobenzene	<0.0206		0.0206		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,2,4-Trichlorobenzene	<0.0206		0.0206		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,1,1-Trichloroethane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,1,2-Trichloroethane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Trichloroethene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Trichlorofluoromethane	<0.0412		0.0412		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,2,3-Trichloropropane	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,2,4-Trimethylbenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
1,3,5-Trimethylbenzene	<0.0103		0.0103		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Vinyl chloride	<0.0206		0.0206		mg/Kg		02/11/25 09:08	02/11/25 22:57	1
Xylenes, Total	<0.0206		0.0206		mg/Kg		02/11/25 09:08	02/11/25 22:57	1

Surrogate	MB	MB	Limits	Prepared	Analyzed	Dil Fac
	%Recovery	Qualifier				
4-Bromofluorobenzene (Surr)	106		80 - 120	02/11/25 09:08	02/11/25 22:57	1
Dibromofluoromethane (Surr)	102		80 - 127	02/11/25 09:08	02/11/25 22:57	1
Toluene-d8 (Surr)	90		80 - 120	02/11/25 09:08	02/11/25 22:57	1

Lab Sample ID: LCS 310-446664/2-A

Matrix: Solid

Analysis Batch: 446665

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 446664

Analyte	Spike Added	LCS	LCS	Unit	D	%Rec	%Rec Limits
		Result	Qualifier				
Acetone	0.166	0.1601		mg/Kg		96	50 - 150
Benzene	0.0831	0.07794		mg/Kg		94	75 - 137
Bromobenzene	0.0831	0.06320		mg/Kg		76	72 - 126
Bromochloromethane	0.0831	0.07435		mg/Kg		90	74 - 142
Bromodichloromethane	0.0831	0.06560		mg/Kg		79	73 - 127
Bromoform	0.0831	0.06836		mg/Kg		82	75 - 131
2-Butanone (MEK)	0.166	0.1969		mg/Kg		119	50 - 150
Carbon disulfide	0.0831	0.06394		mg/Kg		77	53 - 150
Carbon tetrachloride	0.0831	0.07231		mg/Kg		87	71 - 138
Chlorobenzene	0.0831	0.06297		mg/Kg		76	71 - 124

Eurofins Cedar Falls

QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: LCS 310-446664/2-A

Matrix: Solid

Analysis Batch: 446665

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 446664

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Chlorodibromomethane	0.0831	0.06713		mg/Kg		81	76 - 130
Chloroform	0.0831	0.07203		mg/Kg		87	71 - 132
2-Chlorotoluene	0.0831	0.06283		mg/Kg		76	70 - 124
4-Chlorotoluene	0.0831	0.05944		mg/Kg		72	64 - 126
cis-1,2-Dichloroethene	0.0831	0.07282		mg/Kg		88	74 - 138
cis-1,3-Dichloropropene	0.0831	0.06947		mg/Kg		84	76 - 132
1,2-Dibromo-3-chloropropane	0.0831	0.06919		mg/Kg		83	50 - 150
1,2-Dibromoethane (EDB)	0.0831	0.07027		mg/Kg		85	78 - 131
Dibromomethane	0.0831	0.07966		mg/Kg		96	75 - 139
1,1-Dichloroethane	0.0831	0.07573		mg/Kg		91	71 - 142
1,2-Dichloroethane	0.0831	0.07962		mg/Kg		96	72 - 138
1,1-Dichloroethene	0.0831	0.06552		mg/Kg		79	59 - 150
1,2-Dichloropropane	0.0831	0.08367		mg/Kg		101	74 - 139
1,3-Dichloropropane	0.0831	0.08455		mg/Kg		102	74 - 143
2,2-Dichloropropane	0.0831	0.07187		mg/Kg		87	50 - 150
1,1-Dichloropropene	0.0831	0.07396		mg/Kg		89	72 - 137
Ethylbenzene	0.0831	0.06481		mg/Kg		78	73 - 126
Hexachlorobutadiene	0.0831	0.04645	J	mg/Kg		56	50 - 150
Hexane	0.0831	0.05640		mg/Kg		68	41 - 150
Isopropylbenzene	0.0831	0.06592		mg/Kg		79	73 - 126
Methylene chloride	0.0831	0.07105	J	mg/Kg		86	50 - 150
Methyl tert-butyl ether	0.0831	0.07904		mg/Kg		95	71 - 144
Naphthalene	0.0831	0.06315		mg/Kg		76	50 - 150
n-Butylbenzene	0.0831	0.05148		mg/Kg		62	59 - 128
n-Propylbenzene	0.0831	0.06188		mg/Kg		75	69 - 127
p-Isopropyltoluene	0.0831	0.05658		mg/Kg		68	66 - 125
sec-Butylbenzene	0.0831	0.05919		mg/Kg		71	71 - 124
Styrene	0.0831	0.06736		mg/Kg		81	73 - 124
tert-Butylbenzene	0.0831	0.06265		mg/Kg		75	74 - 126
1,1,1,2-Tetrachloroethane	0.0831	0.06668		mg/Kg		80	75 - 129
1,1,2,2-Tetrachloroethane	0.0831	0.07265		mg/Kg		87	74 - 134
Tetrachloroethene	0.0831	0.05606		mg/Kg		67	66 - 127
Toluene	0.0831	0.06514		mg/Kg		78	72 - 126
trans-1,2-Dichloroethene	0.0831	0.06735		mg/Kg		81	69 - 139
trans-1,3-Dichloropropene	0.0831	0.07084		mg/Kg		85	74 - 134
1,2,3-Trichlorobenzene	0.0831	0.05193		mg/Kg		63	50 - 150
1,2,4-Trichlorobenzene	0.0831	0.04629		mg/Kg		56	49 - 135
1,1,1-Trichloroethane	0.0831	0.07472		mg/Kg		90	75 - 136
1,1,2-Trichloroethane	0.0831	0.07103		mg/Kg		86	75 - 134
Trichloroethene	0.0831	0.07284		mg/Kg		88	73 - 134
1,2,3-Trichloropropane	0.0831	0.07645		mg/Kg		92	74 - 131
1,2,4-Trimethylbenzene	0.0831	0.05799		mg/Kg		70	66 - 128
1,3,5-Trimethylbenzene	0.0831	0.05957		mg/Kg		72	69 - 124
Xylenes, Total	0.166	0.1279		mg/Kg		77	70 - 129

Surrogate	LCS LCS		Limits
	%Recovery	Qualifier	
4-Bromofluorobenzene (Surr)	109		80 - 120
Dibromofluoromethane (Surr)	102		80 - 127

Eurofins Cedar Falls

QC Sample Results

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: LCS 310-446664/2-A
Matrix: Solid
Analysis Batch: 446665

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 446664

Surrogate	LCS LCS		Limits
	%Recovery	Qualifier	
Toluene-d8 (Surr)	93		80 - 120

Lab Sample ID: MB 310-446784/1-A
Matrix: Solid
Analysis Batch: 446785

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 446784

Analyte	MB MB		RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
Acetone	<0.488		0.488		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Benzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Bromobenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Bromochloromethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Bromodichloromethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Bromoform	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Bromomethane	<0.488		0.488		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
2-Butanone (MEK)	<0.731		0.731		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Carbon disulfide	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Carbon tetrachloride	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Chlorobenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Chlorodibromomethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Chloroethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Chloroform	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Chloromethane	<0.244		0.244		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
2-Chlorotoluene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
4-Chlorotoluene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
cis-1,2-Dichloroethene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
cis-1,3-Dichloropropene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,2-Dibromo-3-chloropropane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,2-Dibromoethane (EDB)	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Dibromomethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,2-Dichlorobenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,3-Dichlorobenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,4-Dichlorobenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Dichlorodifluoromethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,1-Dichloroethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,2-Dichloroethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,1-Dichloroethene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,2-Dichloropropane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,3-Dichloropropane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
2,2-Dichloropropane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,1-Dichloropropene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Ethylbenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Hexachlorobutadiene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Hexane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Isopropylbenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Methylene chloride	<0.244		0.244		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Methyl tert-butyl ether	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Naphthalene	<0.244		0.244		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
n-Butylbenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1

Eurofins Cedar Falls

QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: MB 310-446784/1-A

Matrix: Solid

Analysis Batch: 446785

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 446784

Analyte	MB	MB	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
n-Propylbenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
p-Isopropyltoluene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
sec-Butylbenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Styrene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
tert-Butylbenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,1,1,2-Tetrachloroethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,1,2,2-Tetrachloroethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Tetrachloroethene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Toluene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
trans-1,2-Dichloroethene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
trans-1,3-Dichloropropene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,2,3-Trichlorobenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,2,4-Trichlorobenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,1,1-Trichloroethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,1,2-Trichloroethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Trichloroethene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Trichlorofluoromethane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,2,3-Trichloropropane	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,2,4-Trimethylbenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
1,3,5-Trimethylbenzene	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Vinyl chloride	<0.0975		0.0975		mg/Kg		02/13/25 07:03	02/13/25 09:35	1
Xylenes, Total	<0.146		0.146		mg/Kg		02/13/25 07:03	02/13/25 09:35	1

Surrogate	MB	MB	Limits	Prepared	Analyzed	Dil Fac
	%Recovery	Qualifier				
4-Bromofluorobenzene (Surr)	104		80 - 120	02/13/25 07:03	02/13/25 09:35	1
Dibromofluoromethane (Surr)	108		80 - 120	02/13/25 07:03	02/13/25 09:35	1
Toluene-d8 (Surr)	102		80 - 120	02/13/25 07:03	02/13/25 09:35	1

Lab Sample ID: LCS 310-446784/2-A

Matrix: Solid

Analysis Batch: 446785

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 446784

Analyte	Spike Added	LCS	LCS	Unit	D	%Rec	%Rec Limits
		Result	Qualifier				
Acetone	1.93	2.357		mg/Kg		122	50 - 150
Benzene	0.963	0.9679		mg/Kg		100	80 - 127
Bromobenzene	0.963	0.9773		mg/Kg		101	80 - 129
Bromochloromethane	0.963	1.102		mg/Kg		114	79 - 141
Bromodichloromethane	0.963	0.9577		mg/Kg		99	72 - 126
Bromoform	0.963	1.024		mg/Kg		106	56 - 140
2-Butanone (MEK)	1.93	2.264		mg/Kg		118	50 - 150
Carbon disulfide	0.963	1.037		mg/Kg		108	63 - 136
Carbon tetrachloride	0.963	1.077		mg/Kg		112	74 - 134
Chlorobenzene	0.963	0.9757		mg/Kg		101	80 - 123
Chlorodibromomethane	0.963	1.008		mg/Kg		105	70 - 127
Chloroform	0.963	1.051		mg/Kg		109	78 - 128
2-Chlorotoluene	0.963	1.028		mg/Kg		107	80 - 123
4-Chlorotoluene	0.963	1.067		mg/Kg		111	79 - 122
cis-1,2-Dichloroethene	0.963	1.044		mg/Kg		108	80 - 131

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QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: LCS 310-446784/2-A

Matrix: Solid

Analysis Batch: 446785

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 446784

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
cis-1,3-Dichloropropene	0.963	0.9672		mg/Kg		100	77 - 127
1,2-Dibromo-3-chloropropane	0.963	0.9569		mg/Kg		99	50 - 150
1,2-Dibromoethane (EDB)	0.963	1.029		mg/Kg		107	80 - 126
Dibromomethane	0.963	1.052		mg/Kg		109	78 - 133
1,2-Dichlorobenzene	0.963	0.9584		mg/Kg		100	80 - 123
1,3-Dichlorobenzene	0.963	0.9928		mg/Kg		103	80 - 124
1,4-Dichlorobenzene	0.963	0.9466		mg/Kg		98	79 - 122
1,1-Dichloroethane	0.963	1.067		mg/Kg		111	75 - 133
1,2-Dichloroethane	0.963	1.067		mg/Kg		111	74 - 135
1,1-Dichloroethene	0.963	1.002		mg/Kg		104	72 - 136
1,2-Dichloropropane	0.963	1.015		mg/Kg		105	80 - 130
1,3-Dichloropropane	0.963	1.010		mg/Kg		105	79 - 130
2,2-Dichloropropane	0.963	1.181		mg/Kg		123	50 - 150
1,1-Dichloropropene	0.963	1.008		mg/Kg		105	80 - 131
Ethylbenzene	0.963	0.9616		mg/Kg		100	80 - 123
Hexachlorobutadiene	0.963	1.055		mg/Kg		110	50 - 150
Hexane	0.963	1.244		mg/Kg		129	45 - 150
Isopropylbenzene	0.963	0.9864		mg/Kg		102	80 - 125
Methylene chloride	0.963	1.010		mg/Kg		105	50 - 150
Methyl tert-butyl ether	0.963	1.039		mg/Kg		108	72 - 136
Naphthalene	0.963	1.003		mg/Kg		104	50 - 150
n-Butylbenzene	0.963	0.9779		mg/Kg		102	71 - 127
n-Propylbenzene	0.963	1.023		mg/Kg		106	79 - 125
p-Isopropyltoluene	0.963	0.9595		mg/Kg		100	76 - 125
sec-Butylbenzene	0.963	0.9742		mg/Kg		101	76 - 125
Styrene	0.963	0.9981		mg/Kg		104	79 - 124
tert-Butylbenzene	0.963	0.9661		mg/Kg		100	78 - 124
1,1,1,2-Tetrachloroethane	0.963	0.9971		mg/Kg		104	78 - 127
1,1,2,2-Tetrachloroethane	0.963	1.054		mg/Kg		109	74 - 131
Tetrachloroethene	0.963	0.9742		mg/Kg		101	80 - 134
Toluene	0.963	0.9202		mg/Kg		96	78 - 126
trans-1,2-Dichloroethene	0.963	1.093		mg/Kg		114	75 - 134
trans-1,3-Dichloropropene	0.963	1.012		mg/Kg		105	74 - 125
1,2,3-Trichlorobenzene	0.963	0.9848		mg/Kg		102	50 - 150
1,2,4-Trichlorobenzene	0.963	1.019		mg/Kg		106	74 - 130
1,1,1-Trichloroethane	0.963	1.017		mg/Kg		106	77 - 134
1,1,2-Trichloroethane	0.963	1.016		mg/Kg		106	80 - 127
Trichloroethene	0.963	0.9828		mg/Kg		102	80 - 130
1,2,3-Trichloropropane	0.963	1.091		mg/Kg		113	75 - 134
1,2,4-Trimethylbenzene	0.963	1.003		mg/Kg		104	73 - 130
1,3,5-Trimethylbenzene	0.963	0.9963		mg/Kg		103	76 - 124
Xylenes, Total	1.93	2.047		mg/Kg		106	80 - 125

Surrogate	LCS LCS		Limits
	%Recovery	Qualifier	
4-Bromofluorobenzene (Surr)	104		80 - 120
Dibromofluoromethane (Surr)	102		80 - 120
Toluene-d8 (Surr)	96		80 - 120

Eurofins Cedar Falls

QC Sample Results

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: MB 310-446943/1-A
 Matrix: Solid
 Analysis Batch: 447035

Client Sample ID: Method Blank
 Prep Type: Total/NA
 Prep Batch: 446943

Analyte	MB	MB	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
Acetone	<0.0500		0.0500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Benzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Bromobenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Bromochloromethane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Bromodichloromethane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Bromoform	<0.0100		0.0100		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Bromomethane	<0.0200		0.0200		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
2-Butanone (MEK)	<0.0200		0.0200		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Carbon disulfide	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Carbon tetrachloride	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Chlorobenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Chlorodibromomethane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Chloroethane	<0.0200		0.0200		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Chloroform	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Chloromethane	<0.0200		0.0200		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
2-Chlorotoluene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
4-Chlorotoluene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
cis-1,2-Dichloroethene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
cis-1,3-Dichloropropene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,2-Dibromo-3-chloropropane	<0.0100		0.0100		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,2-Dibromoethane (EDB)	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Dibromomethane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,2-Dichlorobenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,3-Dichlorobenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,4-Dichlorobenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Dichlorodifluoromethane	<0.0150		0.0150		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,1-Dichloroethane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,2-Dichloroethane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,1-Dichloroethene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,2-Dichloropropane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,3-Dichloropropane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
2,2-Dichloropropane	<0.0200		0.0200		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,1-Dichloropropene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Ethylbenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Hexachlorobutadiene	<0.0250		0.0250		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Hexane	<0.0250		0.0250		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Isopropylbenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Methylene chloride	<0.0500		0.0500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Methyl tert-butyl ether	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Naphthalene	<0.0250		0.0250		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
n-Butylbenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
n-Propylbenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
p-Isopropyltoluene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
sec-Butylbenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Styrene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
tert-Butylbenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,1,1,2-Tetrachloroethane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,1,1,2,2-Tetrachloroethane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1

Eurofins Cedar Falls

QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: MB 310-446943/1-A

Matrix: Solid

Analysis Batch: 447035

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 446943

Analyte	MB	MB	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
Tetrachloroethene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Toluene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
trans-1,2-Dichloroethene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
trans-1,3-Dichloropropene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,2,3-Trichlorobenzene	<0.0100		0.0100		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,2,4-Trichlorobenzene	<0.0100		0.0100		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,1,1-Trichloroethane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,1,2-Trichloroethane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Trichloroethene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Trichlorofluoromethane	<0.0200		0.0200		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,2,3-Trichloropropane	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,2,4-Trimethylbenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
1,3,5-Trimethylbenzene	<0.00500		0.00500		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Vinyl chloride	<0.0100		0.0100		mg/Kg		02/17/25 07:27	02/18/25 06:58	1
Xylenes, Total	<0.0100		0.0100		mg/Kg		02/17/25 07:27	02/18/25 06:58	1

Surrogate	MB	MB	Limits	Prepared	Analyzed	Dil Fac
	%Recovery	Qualifier				
4-Bromofluorobenzene (Surr)	93		80 - 120	02/17/25 07:27	02/18/25 06:58	1
Dibromofluoromethane (Surr)	102		80 - 127	02/17/25 07:27	02/18/25 06:58	1
Toluene-d8 (Surr)	97		80 - 120	02/17/25 07:27	02/18/25 06:58	1

Lab Sample ID: LCS 310-446943/2-A

Matrix: Solid

Analysis Batch: 447035

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 446943

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Benzene	0.0825	0.08104		mg/Kg		98	75 - 137
Bromobenzene	0.0825	0.08462		mg/Kg		103	72 - 126
Bromochloromethane	0.0825	0.07977		mg/Kg		97	74 - 142
Bromodichloromethane	0.0825	0.08407		mg/Kg		102	73 - 127
Bromoform	0.0825	0.08727		mg/Kg		106	75 - 131
2-Butanone (MEK)	0.165	0.1780		mg/Kg		108	50 - 150
Carbon disulfide	0.0825	0.07644		mg/Kg		93	53 - 150
Carbon tetrachloride	0.0825	0.08340		mg/Kg		101	71 - 138
Chlorobenzene	0.0825	0.08470		mg/Kg		103	71 - 124
Chlorodibromomethane	0.0825	0.08593		mg/Kg		104	76 - 130
Chloroform	0.0825	0.07807		mg/Kg		95	71 - 132
2-Chlorotoluene	0.0825	0.08604		mg/Kg		104	70 - 124
4-Chlorotoluene	0.0825	0.08677		mg/Kg		105	64 - 126
cis-1,2-Dichloroethene	0.0825	0.07874		mg/Kg		95	74 - 138
cis-1,3-Dichloropropene	0.0825	0.08639		mg/Kg		105	76 - 132
1,2-Dibromo-3-chloropropane	0.0825	0.08166		mg/Kg		99	50 - 150
1,2-Dibromoethane (EDB)	0.0825	0.08692		mg/Kg		105	78 - 131
Dibromomethane	0.0825	0.08304		mg/Kg		101	75 - 139
1,2-Dichlorobenzene	0.0825	0.08186		mg/Kg		99	71 - 124
1,3-Dichlorobenzene	0.0825	0.08282		mg/Kg		100	67 - 124
1,4-Dichlorobenzene	0.0825	0.08248		mg/Kg		100	65 - 124

Eurofins Cedar Falls

QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8260D - Volatile Organic Compounds by GC/MS (Continued)

Lab Sample ID: LCS 310-446943/2-A

Matrix: Solid

Analysis Batch: 447035

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 446943

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
1,1-Dichloroethane	0.0825	0.07578		mg/Kg		92	71 - 142
1,2-Dichloroethane	0.0825	0.08144		mg/Kg		99	72 - 138
1,1-Dichloroethene	0.0825	0.07932		mg/Kg		96	59 - 150
1,2-Dichloropropane	0.0825	0.08288		mg/Kg		100	74 - 139
1,3-Dichloropropane	0.0825	0.08428		mg/Kg		102	74 - 143
2,2-Dichloropropane	0.0825	0.08057		mg/Kg		98	50 - 150
1,1-Dichloropropene	0.0825	0.08252		mg/Kg		100	72 - 137
Ethylbenzene	0.0825	0.08690		mg/Kg		105	73 - 126
Hexachlorobutadiene	0.0825	0.07702		mg/Kg		93	50 - 150
Hexane	0.0825	0.07488		mg/Kg		91	41 - 150
Isopropylbenzene	0.0825	0.08809		mg/Kg		107	73 - 126
Methylene chloride	0.0825	0.07133		mg/Kg		86	50 - 150
Methyl tert-butyl ether	0.0825	0.07325		mg/Kg		89	71 - 144
Naphthalene	0.0825	0.08221		mg/Kg		100	50 - 150
n-Butylbenzene	0.0825	0.08409		mg/Kg		102	59 - 128
n-Propylbenzene	0.0825	0.08808		mg/Kg		107	69 - 127
p-Isopropyltoluene	0.0825	0.08546		mg/Kg		104	66 - 125
sec-Butylbenzene	0.0825	0.08456		mg/Kg		103	71 - 124
Styrene	0.0825	0.08984		mg/Kg		109	73 - 124
tert-Butylbenzene	0.0825	0.08447		mg/Kg		102	74 - 126
1,1,1,2-Tetrachloroethane	0.0825	0.08716		mg/Kg		106	75 - 129
1,1,2,2-Tetrachloroethane	0.0825	0.08757		mg/Kg		106	74 - 134
Tetrachloroethene	0.0825	0.08408		mg/Kg		102	66 - 127
Toluene	0.0825	0.08477		mg/Kg		103	72 - 126
trans-1,2-Dichloroethene	0.0825	0.07188		mg/Kg		87	69 - 139
trans-1,3-Dichloropropene	0.0825	0.08684		mg/Kg		105	74 - 134
1,2,3-Trichlorobenzene	0.0825	0.07962		mg/Kg		97	50 - 150
1,2,4-Trichlorobenzene	0.0825	0.08021		mg/Kg		97	49 - 135
1,1,1-Trichloroethane	0.0825	0.08258		mg/Kg		100	75 - 136
1,1,2-Trichloroethane	0.0825	0.08469		mg/Kg		103	75 - 134
Trichloroethene	0.0825	0.08105		mg/Kg		98	73 - 134
1,2,3-Trichloropropane	0.0825	0.08715		mg/Kg		106	74 - 131
1,2,4-Trimethylbenzene	0.0825	0.08446		mg/Kg		102	66 - 128
1,3,5-Trimethylbenzene	0.0825	0.08448		mg/Kg		102	69 - 124
Xylenes, Total	0.165	0.1741		mg/Kg		106	70 - 129

Surrogate	LCS LCS		Limits
	%Recovery	Qualifier	
4-Bromofluorobenzene (Surr)	101		80 - 120
Dibromofluoromethane (Surr)	98		80 - 127
Toluene-d8 (Surr)	101		80 - 120

Method: 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)

Lab Sample ID: MB 310-446574/1-A

Matrix: Solid

Analysis Batch: 446588

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 446574

Analyte	MB MB		RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
Gasoline Range Organics [C6-C12]	<9.56		9.56		mg/Kg		02/10/25 10:41	02/11/25 13:53	1

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QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics) (Continued)

<i>Surrogate</i>	<i>MB</i> <i>%Recovery</i>	<i>MB</i> <i>Qualifier</i>	<i>Limits</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Dil Fac</i>
4-Bromofluorobenzene (Surr)	99		47 - 150	02/10/25 10:41	02/11/25 13:53	1

Lab Sample ID: LCS 310-446574/2-A
Matrix: Solid
Analysis Batch: 446588

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 446574

<i>Analyte</i>	<i>Spike</i> <i>Added</i>	<i>LCS</i> <i>Result</i>	<i>LCS</i> <i>Qualifier</i>	<i>Unit</i>	<i>D</i>	<i>%Rec</i>	<i>%Rec</i> <i>Limits</i>
Gasoline Range Organics [C6-C12]	92.4	86.50		mg/Kg		94	69 - 125

<i>Surrogate</i>	<i>LCS</i> <i>%Recovery</i>	<i>LCS</i> <i>Qualifier</i>	<i>Limits</i>
4-Bromofluorobenzene (Surr)	278	S1+	47 - 150

Lab Sample ID: MB 310-446613/5
Matrix: Water
Analysis Batch: 446613

Client Sample ID: Method Blank
Prep Type: Total/NA

<i>Analyte</i>	<i>MB</i> <i>Result</i>	<i>MB</i> <i>Qualifier</i>	<i>RL</i>	<i>MDL</i>	<i>Unit</i>	<i>D</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Dil Fac</i>
Gasoline Range Organics [C6-C12]	<500		500		ug/L			02/11/25 04:43	1

<i>Surrogate</i>	<i>MB</i> <i>%Recovery</i>	<i>MB</i> <i>Qualifier</i>	<i>Limits</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Dil Fac</i>
4-Bromofluorobenzene (Surr)	105		52 - 145		02/11/25 04:43	1

Lab Sample ID: LCS 310-446613/4
Matrix: Water
Analysis Batch: 446613

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

<i>Analyte</i>	<i>Spike</i> <i>Added</i>	<i>LCS</i> <i>Result</i>	<i>LCS</i> <i>Qualifier</i>	<i>Unit</i>	<i>D</i>	<i>%Rec</i>	<i>%Rec</i> <i>Limits</i>
Gasoline Range Organics [C6-C12]	2000	1732		ug/L		87	74 - 121

<i>Surrogate</i>	<i>LCS</i> <i>%Recovery</i>	<i>LCS</i> <i>Qualifier</i>	<i>Limits</i>
4-Bromofluorobenzene (Surr)	166	S1+	52 - 145

Lab Sample ID: MB 310-446819/1-A
Matrix: Solid
Analysis Batch: 446823

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 446819

<i>Analyte</i>	<i>MB</i> <i>Result</i>	<i>MB</i> <i>Qualifier</i>	<i>RL</i>	<i>MDL</i>	<i>Unit</i>	<i>D</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Dil Fac</i>
Gasoline Range Organics [C6-C12]	<9.22		9.22		mg/Kg		02/13/25 10:23	02/13/25 21:56	1

<i>Surrogate</i>	<i>MB</i> <i>%Recovery</i>	<i>MB</i> <i>Qualifier</i>	<i>Limits</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Dil Fac</i>
4-Bromofluorobenzene (Surr)	105		47 - 150	02/13/25 10:23	02/13/25 21:56	1

QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8015C - Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics) (Continued)

Lab Sample ID: LCS 310-446819/2-A
Matrix: Solid
Analysis Batch: 446823

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 446819

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Gasoline Range Organics [C6-C12]	94.6	92.76		mg/Kg		98	69 - 125
Surrogate	%Recovery	LCS Qualifier	Limits				
4-Bromofluorobenzene (Surr)	271	S1+	47 - 150				

Method: 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

Lab Sample ID: MB 310-446619/1-A
Matrix: Water
Analysis Batch: 446871

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 446619

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	<300		300		ug/L		02/10/25 14:42	02/14/25 09:57	1
Surrogate	%Recovery	MB Qualifier	Limits				Prepared	Analyzed	Dil Fac
n-Octacosane	112		32 - 144				02/10/25 14:42	02/14/25 09:57	1

Lab Sample ID: LCS 310-446619/2-A
Matrix: Water
Analysis Batch: 446871

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 446619

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Diesel Range Organics [C10-C28]	4000	2971		ug/L		74	42 - 121
Surrogate	%Recovery	LCS Qualifier	Limits				
n-Octacosane	80		32 - 144				

Lab Sample ID: LCSD 310-446619/3-A
Matrix: Water
Analysis Batch: 446871

Client Sample ID: Lab Control Sample Dup
Prep Type: Total/NA
Prep Batch: 446619

Analyte	Spike Added	LCSD Result	LCSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	Limit
Diesel Range Organics [C10-C28]	4000	2306		ug/L		58	42 - 121	25	34
Surrogate	%Recovery	LCSD Qualifier	Limits						
n-Octacosane	68		32 - 144						

Lab Sample ID: MB 310-446752/1-A
Matrix: Solid
Analysis Batch: 446787

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 446752

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Diesel Range Organics [C10-C28]	<9.79		9.79		mg/Kg		02/12/25 10:18	02/14/25 00:40	1

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QC Sample Results

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method: 8015C - Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)

(Continued)

Lab Sample ID: MB 310-446752/1-A

Matrix: Solid

Analysis Batch: 446787

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 446752

Surrogate	MB MB		Limits	Prepared	Analyzed	Dil Fac
	%Recovery	Qualifier				
n-Octacosane	101		12 - 150	02/12/25 10:18	02/14/25 00:40	1

Lab Sample ID: LCS 310-446752/2-A

Matrix: Solid

Analysis Batch: 446787

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 446752

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Diesel Range Organics [C10-C28]	125	111.6		mg/Kg		89	54 - 121

Surrogate	LCS LCS		Limits
	%Recovery	Qualifier	
n-Octacosane	107		12 - 150

Lab Sample ID: MB 310-446980/1-A

Matrix: Solid

Analysis Batch: 447030

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 446980

Analyte	MB MB		RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
	Result	Qualifier							
Diesel Range Organics [C10-C28]	<10.0		10.0		mg/Kg		02/17/25 10:28	02/18/25 10:35	1

Surrogate	MB MB		Limits	Prepared	Analyzed	Dil Fac
	%Recovery	Qualifier				
n-Octacosane	91		12 - 150	02/17/25 10:28	02/18/25 10:35	1

Lab Sample ID: LCS 310-446980/2-A

Matrix: Solid

Analysis Batch: 447030

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 446980

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Diesel Range Organics [C10-C28]	131	115.5		mg/Kg		88	54 - 121

Surrogate	LCS LCS		Limits
	%Recovery	Qualifier	
n-Octacosane	89		12 - 150

QC Association Summary

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

GC/MS VOA

Analysis Batch: 446646

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-7	MW-02	Total/NA	Water	8260D	
310-300055-8	MW-03	Total/NA	Water	8260D	
310-300055-9	HCL Blank	Total/NA	Water	8260D	
MB 310-446646/5	Method Blank	Total/NA	Water	8260D	
LCS 310-446646/6	Lab Control Sample	Total/NA	Water	8260D	
LCS 310-446646/7	Lab Control Sample	Total/NA	Water	8260D	

Prep Batch: 446661

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-1	SB-01 (10-12.5)	Total/NA	Solid	5035	
310-300055-4	SB-04 (12.5-15)	Total/NA	Solid	5035	
310-300055-5	SB-05 (10-12.5)	Total/NA	Solid	5035	
310-300055-6	SB-06 (7.5-10)	Total/NA	Solid	5035	
MB 310-446661/1-A	Method Blank	Total/NA	Solid	5035	
LCS 310-446661/2-A	Lab Control Sample	Total/NA	Solid	5035	

Analysis Batch: 446663

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-1	SB-01 (10-12.5)	Total/NA	Solid	8260D	446661
310-300055-4	SB-04 (12.5-15)	Total/NA	Solid	8260D	446661
310-300055-5	SB-05 (10-12.5)	Total/NA	Solid	8260D	446661
310-300055-6	SB-06 (7.5-10)	Total/NA	Solid	8260D	446661
MB 310-446661/1-A	Method Blank	Total/NA	Solid	8260D	446661
LCS 310-446661/2-A	Lab Control Sample	Total/NA	Solid	8260D	446661

Prep Batch: 446664

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-3	SB-03 (7.5-10)	Total/NA	Solid	5035	
MB 310-446664/1-A	Method Blank	Total/NA	Solid	5035	
LCS 310-446664/2-A	Lab Control Sample	Total/NA	Solid	5035	

Analysis Batch: 446665

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-3	SB-03 (7.5-10)	Total/NA	Solid	8260D	446664
MB 310-446664/1-A	Method Blank	Total/NA	Solid	8260D	446664
LCS 310-446664/2-A	Lab Control Sample	Total/NA	Solid	8260D	446664

Prep Batch: 446784

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-2	SB-02 (17.5-20)	Total/NA	Solid	5035	
MB 310-446784/1-A	Method Blank	Total/NA	Solid	5035	
LCS 310-446784/2-A	Lab Control Sample	Total/NA	Solid	5035	

Analysis Batch: 446785

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-2	SB-02 (17.5-20)	Total/NA	Solid	8260D	446784
MB 310-446784/1-A	Method Blank	Total/NA	Solid	8260D	446784
LCS 310-446784/2-A	Lab Control Sample	Total/NA	Solid	8260D	446784

QC Association Summary

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

GC/MS VOA

Prep Batch: 446943

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-3	SB-03 (7.5-10)	Total/NA	Solid	5035	
MB 310-446943/1-A	Method Blank	Total/NA	Solid	5035	
LCS 310-446943/2-A	Lab Control Sample	Total/NA	Solid	5035	

Analysis Batch: 447035

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-3	SB-03 (7.5-10)	Total/NA	Solid	8260D	446943
MB 310-446943/1-A	Method Blank	Total/NA	Solid	8260D	446943
LCS 310-446943/2-A	Lab Control Sample	Total/NA	Solid	8260D	446943

GC VOA

Prep Batch: 446574

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-1	SB-01 (10-12.5)	Total/NA	Solid	5035	
310-300055-2	SB-02 (17.5-20)	Total/NA	Solid	5035	
310-300055-3	SB-03 (7.5-10)	Total/NA	Solid	5035	
310-300055-5	SB-05 (10-12.5)	Total/NA	Solid	5035	
310-300055-6	SB-06 (7.5-10)	Total/NA	Solid	5035	
MB 310-446574/1-A	Method Blank	Total/NA	Solid	5035	
LCS 310-446574/2-A	Lab Control Sample	Total/NA	Solid	5035	

Analysis Batch: 446588

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-1	SB-01 (10-12.5)	Total/NA	Solid	8015C	446574
310-300055-2	SB-02 (17.5-20)	Total/NA	Solid	8015C	446574
310-300055-3	SB-03 (7.5-10)	Total/NA	Solid	8015C	446574
310-300055-5	SB-05 (10-12.5)	Total/NA	Solid	8015C	446574
310-300055-6	SB-06 (7.5-10)	Total/NA	Solid	8015C	446574
MB 310-446574/1-A	Method Blank	Total/NA	Solid	8015C	446574
LCS 310-446574/2-A	Lab Control Sample	Total/NA	Solid	8015C	446574

Analysis Batch: 446613

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-7	MW-02	Total/NA	Water	8015C	
310-300055-8	MW-03	Total/NA	Water	8015C	
310-300055-9	HCL Blank	Total/NA	Water	8015C	
MB 310-446613/5	Method Blank	Total/NA	Water	8015C	
LCS 310-446613/4	Lab Control Sample	Total/NA	Water	8015C	

Prep Batch: 446819

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-4	SB-04 (12.5-15)	Total/NA	Solid	5035	
MB 310-446819/1-A	Method Blank	Total/NA	Solid	5035	
LCS 310-446819/2-A	Lab Control Sample	Total/NA	Solid	5035	

Analysis Batch: 446823

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-4	SB-04 (12.5-15)	Total/NA	Solid	8015C	446819
MB 310-446819/1-A	Method Blank	Total/NA	Solid	8015C	446819
LCS 310-446819/2-A	Lab Control Sample	Total/NA	Solid	8015C	446819

Eurofins Cedar Falls

QC Association Summary

Client: Braun Intertec Corporation
 Project/Site: Ellendale School

Job ID: 310-300055-1
 SDG: B2500693

GC Semi VOA

Prep Batch: 446619

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-7	MW-02	Total/NA	Water	3510C	
310-300055-8	MW-03	Total/NA	Water	3510C	
MB 310-446619/1-A	Method Blank	Total/NA	Water	3510C	
LCS 310-446619/2-A	Lab Control Sample	Total/NA	Water	3510C	
LCSD 310-446619/3-A	Lab Control Sample Dup	Total/NA	Water	3510C	

Prep Batch: 446752

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-1	SB-01 (10-12.5)	Total/NA	Solid	3546	
310-300055-3	SB-03 (7.5-10)	Total/NA	Solid	3546	
310-300055-4	SB-04 (12.5-15)	Total/NA	Solid	3546	
310-300055-5	SB-05 (10-12.5)	Total/NA	Solid	3546	
310-300055-6	SB-06 (7.5-10)	Total/NA	Solid	3546	
MB 310-446752/1-A	Method Blank	Total/NA	Solid	3546	
LCS 310-446752/2-A	Lab Control Sample	Total/NA	Solid	3546	

Analysis Batch: 446787

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-1	SB-01 (10-12.5)	Total/NA	Solid	8015C	446752
310-300055-3	SB-03 (7.5-10)	Total/NA	Solid	8015C	446752
310-300055-4	SB-04 (12.5-15)	Total/NA	Solid	8015C	446752
310-300055-5	SB-05 (10-12.5)	Total/NA	Solid	8015C	446752
310-300055-6	SB-06 (7.5-10)	Total/NA	Solid	8015C	446752
310-300055-7	MW-02	Total/NA	Water	8015C	446619
310-300055-8	MW-03	Total/NA	Water	8015C	446619
MB 310-446752/1-A	Method Blank	Total/NA	Solid	8015C	446752
LCS 310-446752/2-A	Lab Control Sample	Total/NA	Solid	8015C	446752

Analysis Batch: 446871

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-7	MW-02	Total/NA	Water	8015C	446619
MB 310-446619/1-A	Method Blank	Total/NA	Water	8015C	446619
LCS 310-446619/2-A	Lab Control Sample	Total/NA	Water	8015C	446619
LCSD 310-446619/3-A	Lab Control Sample Dup	Total/NA	Water	8015C	446619

Prep Batch: 446980

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-2	SB-02 (17.5-20)	Total/NA	Solid	3546	
MB 310-446980/1-A	Method Blank	Total/NA	Solid	3546	
LCS 310-446980/2-A	Lab Control Sample	Total/NA	Solid	3546	

Analysis Batch: 447030

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-2	SB-02 (17.5-20)	Total/NA	Solid	8015C	446980
MB 310-446980/1-A	Method Blank	Total/NA	Solid	8015C	446980
LCS 310-446980/2-A	Lab Control Sample	Total/NA	Solid	8015C	446980

QC Association Summary

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

General Chemistry

Analysis Batch: 446516

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-300055-1	SB-01 (10-12.5)	Total/NA	Solid	Moisture	
310-300055-2	SB-02 (17.5-20)	Total/NA	Solid	Moisture	
310-300055-3	SB-03 (7.5-10)	Total/NA	Solid	Moisture	
310-300055-4	SB-04 (12.5-15)	Total/NA	Solid	Moisture	
310-300055-5	SB-05 (10-12.5)	Total/NA	Solid	Moisture	
310-300055-6	SB-06 (7.5-10)	Total/NA	Solid	Moisture	

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Lab Chronicle

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-01 (10-12.5)

Lab Sample ID: 310-300055-1

Date Collected: 02/04/25 11:05

Matrix: Solid

Date Received: 02/07/25 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	446516	A3GU	EET CF	02/08/25 11:49

Client Sample ID: SB-01 (10-12.5)

Lab Sample ID: 310-300055-1

Date Collected: 02/04/25 11:05

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 80.1

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	5035			446661	MZR8	EET CF	02/11/25 09:03
Total/NA	Analysis	8260D		1	446663	MZR8	EET CF	02/11/25 15:44
Total/NA	Prep	5035			446574	P5ZC	EET CF	02/10/25 10:41
Total/NA	Analysis	8015C		1	446588	P5ZC	EET CF	02/11/25 18:11
Total/NA	Prep	3546			446752	BDJ4	EET CF	02/12/25 10:18
Total/NA	Analysis	8015C		1	446787	C3AA	EET CF	02/14/25 03:04

Client Sample ID: SB-02 (17.5-20)

Lab Sample ID: 310-300055-2

Date Collected: 02/04/25 11:55

Matrix: Solid

Date Received: 02/07/25 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	446516	A3GU	EET CF	02/08/25 11:49

Client Sample ID: SB-02 (17.5-20)

Lab Sample ID: 310-300055-2

Date Collected: 02/04/25 11:55

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 80.5

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	5035			446784	MZR8	EET CF	02/13/25 07:03
Total/NA	Analysis	8260D		1	446785	MZR8	EET CF	02/13/25 17:15
Total/NA	Prep	5035			446574	P5ZC	EET CF	02/10/25 10:41
Total/NA	Analysis	8015C		1	446588	P5ZC	EET CF	02/11/25 18:37
Total/NA	Prep	3546			446980	BDJ4	EET CF	02/17/25 10:28
Total/NA	Analysis	8015C		1	447030	C3AA	EET CF	02/18/25 11:04

Client Sample ID: SB-03 (7.5-10)

Lab Sample ID: 310-300055-3

Date Collected: 02/04/25 13:55

Matrix: Solid

Date Received: 02/07/25 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	446516	A3GU	EET CF	02/08/25 11:49

Lab Chronicle

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-03 (7.5-10)

Lab Sample ID: 310-300055-3

Date Collected: 02/04/25 13:55

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 82.3

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	5035			446664	MZR8	EET CF	02/11/25 09:08
Total/NA	Analysis	8260D		1	446665	MZR8	EET CF	02/12/25 02:34
Total/NA	Prep	5035			446943	MZR8	EET CF	02/17/25 07:27
Total/NA	Analysis	8260D		1	447035	MZR8	EET CF	02/18/25 08:11
Total/NA	Prep	5035			446574	P5ZC	EET CF	02/10/25 10:41
Total/NA	Analysis	8015C		1	446588	P5ZC	EET CF	02/11/25 19:03
Total/NA	Prep	3546			446752	BDJ4	EET CF	02/12/25 10:18
Total/NA	Analysis	8015C		1	446787	C3AA	EET CF	02/14/25 03:19

Client Sample ID: SB-04 (12.5-15)

Lab Sample ID: 310-300055-4

Date Collected: 02/04/25 14:50

Matrix: Solid

Date Received: 02/07/25 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	446516	A3GU	EET CF	02/08/25 11:49

Client Sample ID: SB-04 (12.5-15)

Lab Sample ID: 310-300055-4

Date Collected: 02/04/25 14:50

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 80.8

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	5035			446661	MZR8	EET CF	02/11/25 09:03
Total/NA	Analysis	8260D		1	446663	MZR8	EET CF	02/11/25 16:08
Total/NA	Prep	5035			446819	P5ZC	EET CF	02/13/25 10:23
Total/NA	Analysis	8015C		1	446823	P5ZC	EET CF	02/14/25 00:30
Total/NA	Prep	3546			446752	BDJ4	EET CF	02/12/25 10:18
Total/NA	Analysis	8015C		1	446787	C3AA	EET CF	02/14/25 03:33

Client Sample ID: SB-05 (10-12.5)

Lab Sample ID: 310-300055-5

Date Collected: 02/04/25 15:40

Matrix: Solid

Date Received: 02/07/25 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	446516	A3GU	EET CF	02/08/25 11:49

Client Sample ID: SB-05 (10-12.5)

Lab Sample ID: 310-300055-5

Date Collected: 02/04/25 15:40

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 81.8

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	5035			446661	MZR8	EET CF	02/11/25 09:03
Total/NA	Analysis	8260D		1	446663	MZR8	EET CF	02/11/25 16:32
Total/NA	Prep	5035			446574	P5ZC	EET CF	02/10/25 10:41
Total/NA	Analysis	8015C		1	446588	P5ZC	EET CF	02/11/25 19:54
Total/NA	Prep	3546			446752	BDJ4	EET CF	02/12/25 10:18
Total/NA	Analysis	8015C		1	446787	C3AA	EET CF	02/14/25 03:48

Eurofins Cedar Falls

Lab Chronicle

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Client Sample ID: SB-06 (7.5-10)

Lab Sample ID: 310-300055-6

Date Collected: 02/04/25 16:15

Matrix: Solid

Date Received: 02/07/25 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	Moisture		1	446516	A3GU	EET CF	02/08/25 11:49

Client Sample ID: SB-06 (7.5-10)

Lab Sample ID: 310-300055-6

Date Collected: 02/04/25 16:15

Matrix: Solid

Date Received: 02/07/25 09:00

Percent Solids: 79.8

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Prep	5035			446661	MZR8	EET CF	02/11/25 09:03
Total/NA	Analysis	8260D		1	446663	MZR8	EET CF	02/11/25 16:56
Total/NA	Prep	5035			446574	P5ZC	EET CF	02/10/25 10:41
Total/NA	Analysis	8015C		1	446588	P5ZC	EET CF	02/11/25 20:20
Total/NA	Prep	3546			446752	BDJ4	EET CF	02/12/25 10:18
Total/NA	Analysis	8015C		1	446787	C3AA	EET CF	02/14/25 04:02

Client Sample ID: MW-02

Lab Sample ID: 310-300055-7

Date Collected: 02/04/25 12:00

Matrix: Water

Date Received: 02/07/25 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	8260D		5	446646	WSE8	EET CF	02/11/25 16:42
Total/NA	Analysis	8015C		5	446613	P5ZC	EET CF	02/11/25 13:24
Total/NA	Prep	3510C			446619	AYK7	EET CF	02/10/25 14:42
Total/NA	Analysis	8015C		1	446787	C3AA	EET CF	02/13/25 18:51
Total/NA	Prep	3510C			446619	AYK7	EET CF	02/10/25 14:42
Total/NA	Analysis	8015C		50	446871	C3AA	EET CF	02/14/25 12:23

Client Sample ID: MW-03

Lab Sample ID: 310-300055-8

Date Collected: 02/04/25 14:00

Matrix: Water

Date Received: 02/07/25 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	8260D		5	446646	WSE8	EET CF	02/11/25 17:04
Total/NA	Analysis	8015C		5	446613	P5ZC	EET CF	02/11/25 13:53
Total/NA	Prep	3510C			446619	AYK7	EET CF	02/10/25 14:42
Total/NA	Analysis	8015C		1	446787	C3AA	EET CF	02/13/25 18:37

Client Sample ID: HCL Blank

Lab Sample ID: 310-300055-9

Date Collected: 02/04/25 00:00

Matrix: Water

Date Received: 02/07/25 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Batch Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	8260D		1	446646	WSE8	EET CF	02/11/25 11:27
Total/NA	Analysis	8015C		1	446613	P5ZC	EET CF	02/11/25 05:12

Lab Chronicle

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Laboratory References:

EET CF = Eurofins Cedar Falls, 3019 Venture Way, Cedar Falls, IA 50613, TEL (319)277-2401

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Accreditation/Certification Summary

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Laboratory: Eurofins Cedar Falls

Unless otherwise noted, all analytes for this laboratory were covered under each accreditation/certification below.

Authority	Program	Identification Number	Expiration Date
North Dakota	State	R-186	09-29-24 *

The following analytes are included in this report, but the laboratory is not certified by the governing authority. This list may include analytes for which the agency does not offer certification.

Analysis Method	Prep Method	Matrix	Analyte
Moisture		Solid	Percent Moisture
Moisture		Solid	Percent Solids

* Accreditation/Certification renewal pending - accreditation/certification considered valid.

Method Summary

Client: Braun Intertec Corporation
Project/Site: Ellendale School

Job ID: 310-300055-1
SDG: B2500693

Method	Method Description	Protocol	Laboratory
8260D	Volatile Organic Compounds by GC/MS	SW846	EET CF
8015C	Nonhalogenated Organics using GC/FID -Modified (Gasoline Range Organics)	SW846	EET CF
8015C	Nonhalogenated Organics using GC/FID -Modified (Diesel Range Organics)	SW846	EET CF
Moisture	Percent Moisture	EPA	EET CF
3510C	Liquid-Liquid Extraction (Separatory Funnel)	SW846	EET CF
3546	Microwave Extraction	SW846	EET CF
5030B	Purge and Trap	SW846	EET CF
5035	Purge and Trap for Methanol Extractions	SW846	EET CF
5035	Purge and Trap for Solids	SW846	EET CF

Protocol References:

EPA = US Environmental Protection Agency

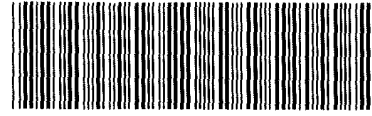
SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

EET CF = Eurofins Cedar Falls, 3019 Venture Way, Cedar Falls, IA 50613, TEL (319)277-2401



Environment Testing
America



310-300055 Chain of Custody

Cooler/Sample Receipt and Temperature Log Form

Client Information			
Client: <u>Brown</u>			
City/State:	<u>Bismark</u> <small>CITY</small>	<u>ND</u> <small>STATE</small>	Project:
Receipt Information			
Date/Time Received:	<u>2/7/25</u> <small>DATE</small>	<u>900</u> <small>TIME</small>	Received By: <u>XB</u>
Delivery Type: <input type="checkbox"/> UPS <input checked="" type="checkbox"/> FedEx <input type="checkbox"/> FedEx Ground <input type="checkbox"/> US Mail <input type="checkbox"/> Spee-Dee <input type="checkbox"/> Lab Courier <input type="checkbox"/> Lab Field Services <input type="checkbox"/> Client Drop-off <input type="checkbox"/> Other: _____			
Condition of Cooler/Containers			
Sample(s) received in Cooler?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	If yes: Cooler ID: _____	
Multiple Coolers?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	If yes: Cooler # _____ of _____	
Cooler Custody Seals Present?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	If yes: Cooler custody seals intact? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Sample Custody Seals Present?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	If yes: Sample custody seals intact? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Trip Blank Present?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	If yes: Which VOA samples are in cooler? ↓	
<u>all</u>			
Temperature Record			
Coolant:	<input checked="" type="checkbox"/> Wet ice <input type="checkbox"/> Blue ice <input type="checkbox"/> Dry ice <input type="checkbox"/> Other: _____ <input type="checkbox"/> NONE		
Thermometer ID:	<u>2</u>	Correction Factor (°C):	<u>0</u>
• Temp Blank Temperature – If no temp blank, or temp blank temperature above criteria, proceed to Sample Container Temperature			
Uncorrected Temp (°C):	<u>3.9</u>	Corrected Temp (°C):	<u>3.9</u>
• Sample Container Temperature			
Container(s) used:	<u>CONTAINER 1</u>	<u>CONTAINER 2</u>	
Uncorrected Temp (°C):			
Corrected Temp (°C):			
Exceptions Noted			
1) If temperature exceeds criteria, was sample(s) received same day of sampling? <input type="checkbox"/> Yes <input type="checkbox"/> No			
a) If yes: Is there evidence that the chilling process began? <input type="checkbox"/> Yes <input type="checkbox"/> No			
2) If temperature is <0°C, are there obvious signs that the integrity of sample containers is compromised? (e.g., bulging septa, broken/cracked bottles, frozen solid?) <input type="checkbox"/> Yes <input type="checkbox"/> No			
NOTE If yes, contact PM before proceeding If no, proceed with login			
Additional Comments			

Chain of Custody Record 731308



Environment Testing
America

TAL-8210

Address _____

Regulatory Program: DW NPDES RCRA Other

Client Contact		Project Manager <i>Jenna McManey</i>		Site Contact		Date <i>2/5/24</i>		COC No	
Company Name <i>Brown MCAEC</i>		Tel/Email <i>mcmaney@brownmcaec.com</i>		Lab Contact		Carrier		____ of ____ COCs	
Address <i>2903 Morrison Ave Suite #3</i>		Analysis Turnaround Time <input type="checkbox"/> CALENDAR DAYS <input type="checkbox"/> WORKING DAYS TAT if different from Below _____		Filtered Sample (Y/N) Perform MS/MSD (Y/N)		TPH as DROPPA 2015 TPH GRO EPA 2012 VOC EPA 8460		Sampler	
City/State/Zip <i>Bismarck ND 58504</i>								For Lab Use Only	
Phone _____								Walk-in Client	
Fax _____								Lab Sampling	
Project Name <i>Elmwood School B2500693</i>								Job / SDG No	
Site <i>Elmwood, ND</i>									
PO# _____									

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.														Sample Specific Notes	
SB-01 (10-12.5')	2/4/25	1105	G	S	2		X	X	X											
SB-02 (17.5-20')	2/4/25	1155	G	S	2		X	X	X											
SB-03 (7.5-10')	2/4/25	1200	G	S	2		X	X	X											
SB-04 (12.5-15')	2/4/25	1450	G	S	2		X	X	X											
SB-05 (10-12.5')	2/4/25	1540	G	S	2		X	X	X											
SB-06 (7.5-10')	2/4/25	1615	G	S	2		X	X	X											
MW-02	2/4/25	1200	G	W	8		X	X	X											
MW-03	2/4/25	1400	G	W	4		X	X	X											Low water

Preservation Used: 1= Ice, 2= HCl, 3= H2SO4, 4= HNO3, 5= NaOH, 6= Other _____

Possible Hazard Identification
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample

Non-Hazard Flammable Skin Irritant Poison B Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
 Return to Client Disposal by Lab Archive for _____ Months

Special Instructions/QC Requirements & Comments

Custody Seals Intact: <input type="checkbox"/> Yes <input type="checkbox"/> No		Custody Seal No		Cooler Temp (°C) Obs'd _____ Cor'd _____		Therm ID No _____	
Relinquished by <i>Jenna McManey</i>		Company <i>Brown</i>		Date/Time <i>2/4/25 1200</i>		Received by _____	
Relinquished by _____		Company _____		Date/Time _____		Received by _____	
Relinquished by _____		Company _____		Date/Time _____		Received in Laboratory by <i>PT</i>	
						Company _____	
						Date/Time <i>2-7-25 900</i>	

2/19/2025



Login Sample Receipt Checklist

Client: Braun Intertec Corporation

Job Number: 310-300055-1

SDG Number: B2500693

Login Number: 300055

List Number: 1

Creator: Hirsch, Preston

List Source: Eurofins Cedar Falls

Question	Answer	Comment
Radioactivity wasn't checked or is <=/ background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	



**SECTION 011000
SUMMARY**

PART 1 GENERAL

1.01 PROJECT

- A. Project Name: Ellendale Public School Addition.
- B. Owner's Name: Ellendale Public School District #40.
- C. Architect's Name: CO-OP Architecture.
- D. The Project consists of the alteration of and addition to the Ellendale Public School including selective demolition, new wrestling room, restrooms, locker rooms, weight room, finishes, mechanical, plumbing, electrical, fire sprinkler, site improvements, utilities, and other improvements.

1.02 DESCRIPTION OF ALTERATIONS WORK

- A. Scope of alterations work is indicated on drawings.
- B. Plumbing: Alter existing and add new construction.
- C. HVAC: Alter existing and add new construction.
- D. Electrical Power and Lighting: Alter existing and add new construction.
- E. Fire Suppression Sprinklers: Add new construction..
- F. Fire Alarm: Alter existing system and add new construction, keeping existing in operation.
- G. Telephone: Alter existing system and add new construction, keeping existing in operation.
- H. Security System: Alter existing system and add new construction, keeping existing in operation.
- I. Civil/Utilities: Alter existing and add new construction.

1.03 OWNER OCCUPANCY

- A. Owner intends to occupy the Project by the date stated in the Agreement as the contract completion date.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

1.04 CONTRACTOR USE OF SITE AND PREMISES

- A. Construction Operations: Limited to areas noted on Drawings.
- B. Arrange use of site and premises to allow:
 - 1. Work by Others.
 - 2. Work by Owner.
 - 3. Use of site and premises by the public.
- C. Provide access to and from site as required by law and by Owner:
 - 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 - 2. Do not obstruct roadways, sidewalks, or other public ways without permit.
- D. Existing building spaces may not be used for storage.
- E. Utility Outages and Shutdown:
 - 1. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
 - 2. Prevent accidental disruption of utility services to other facilities.

1.05 WORK SEQUENCE

- A. The project shall be substantially complete by **July 17, 2026**.

B. Coordinate construction schedule and operations with Owner.

END OF SECTION

**SECTION 012000
PRICE AND PAYMENT PROCEDURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedures for preparation and submittal of applications for progress payments.

1.02 SCHEDULE OF VALUES

- A. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
- B. Forms filled out by hand will not be accepted.
- C. Submit Schedule of Values in duplicate within 15 days after date of Owner-Contractor Agreement.

1.03 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Payment Period: Submit at intervals stipulated in the Agreement.
- B. Forms filled out by hand will not be accepted.
- C. For each item, provide a column for listing each of the following:
 - 1. Item Number.
 - 2. Description of work.
 - 3. Scheduled Values.
 - 4. Previous Applications.
 - 5. Work in Place and Stored Materials under this Application.
 - 6. Authorized Change Orders.
 - 7. Total Completed and Stored to Date of Application.
 - 8. Percentage of Completion.
 - 9. Balance to Finish.
 - 10. Retainage.
- D. Execute certification by signature of authorized officer.
- E. Submit three copies of each Application for Payment.

1.04 MODIFICATION PROCEDURES

- A. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.
- B. For other required changes, Architect will issue a document signed by Owner instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
 - 1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
 - 2. Promptly execute the change.
- C. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 7 days.
- D. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
- E. Substantiation of Costs: Provide full information required for evaluation.
 - 1. On request, provide the following data:
 - a. Quantities of products, labor, and equipment.
 - b. Taxes, insurance, and bonds.
 - c. Overhead and profit.

- d. Justification for any change in Contract Time.
- e. Credit for deletions from Contract, similarly documented.
- F. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.

1.05 APPLICATION FOR FINAL PAYMENT

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:
 - 1. All closeout procedures specified in Section 017000.

END OF SECTION

**SECTION 012200
UNIT PRICES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. List of unit prices, for use in preparing Bids.
- B. Measurement and payment criteria applicable to Work performed under a unit price payment method.

1.02 RELATED REQUIREMENTS

- A. Section 012000 - Price and Payment Procedures: Additional payment and modification procedures.

1.03 COSTS INCLUDED

- A. Unit Prices included on the Bid Form shall include full compensation for all required labor, products, tools, equipment, plant, transportation, services and incidentals; erection, application or installation of an item of the Work; overhead and profit.

1.04 UNIT QUANTITIES SPECIFIED

- A. Quantities indicated in the Bid Form are for bidding and contract purposes only. Quantities and measurements of actual Work will determine the payment amount.

1.05 MEASUREMENT OF QUANTITIES

- A. Measurement methods delineated in the individual specification sections complement the criteria of this section. In the event of conflict, the requirements of the individual specification section govern.
- B. Take all measurements and compute quantities. Measurements and quantities will be verified by Architect in association with Owner's testing agency.
- C. Assist by providing necessary equipment, workers, and survey personnel as required.
- D. Measurement by Volume: Measured by cubic dimension using mean length, width and height or thickness.

1.06 PAYMENT

- A. Payment for Work governed by unit prices will be made on the basis of the actual measurements and quantities of Work that is incorporated in or made necessary by the Work and accepted by the Architect, multiplied by the unit price.
- B. Payment will not be made for any of the following:
 - 1. Products wasted or disposed of in a manner that is not acceptable.
 - 2. Products determined as unacceptable before or after placement.
 - 3. Products not completely unloaded from the transporting vehicle.
 - 4. Products placed beyond the lines and levels of the required Work.
 - 5. Products remaining on hand after completion of the Work.
 - 6. Loading, hauling, and disposing of rejected Products.
 - 7. Any work that is not properly documented at the time of removal or placement

1.07 SCHEDULE OF UNIT PRICES

- A. Item 1 – Imported and Compacted Fill: \$ _____ per CY.
- B. Item 2 – Over Excavation of Unsuitable Material: \$ _____ per CY

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 012300
ALTERNATES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Description of Alternates.

1.02 ACCEPTANCE OF ALTERNATES

- A. Alternates quoted on Bid Forms will be reviewed and accepted or rejected at Owner's option. Accepted Alternates will be identified in the Contractor Agreement.
- B. Coordinate related work and modify surrounding work to integrate the Work of each Alternate.

1.03 SCHEDULE OF ALTERNATES

- A. Alternate No. 1 - NE Parking Lot Area :
1. As shown and indicated on the contract drawings, all necessary work to construct the new asphalt parking lot area, including but not limited to excavation and grading, concrete curb & gutter, concrete and asphalt pavement, plantings, pavement markings, lighting, and wiring. See contract drawings for details.
- B. Alternate No. 2 - SW Site Improvements :
1. As shown and indicated on the contract drawings, all necessary work to construct the new grass area in the SW corner of the site. Including but not limited to excavation and grading, topsoiling and planting, electrical outlet improvements, and domestic water stub out to be irrigation ready. See contract drawings for details.
- C. Alternate No. 3 - North Area Landscape Improvements :
1. As shown and indicated on the contract documents, all necessary work to construct landscape areas west of the north entrance and between building area A and H, including but not limited to planted grass areas, cast-in-place concrete planter boxes, and planter plantings. See contract drawings for details.
- D. Alternate No. 4 - Existing North Façade Improvements :
1. As shown and indicated on the contract drawings, all necessary work to improve existing EIFS building façade along the exterior of the building. Including but not limited to new metal panel, flashings, coping, and signage. See contract drawings for details.
- E. Alternate No. 5 - Fire Suppression Upgrade :
1. As shown and indicated on the contract drawings, all necessary work to provide fire suppression throughout existing school, including but not limited to existing ceiling modifications, fire suppression materials and installation costs. Fire suppression in new addition only, to be a part of the base bid. See contract drawings for details.
- F. Alternate No. 6 - Wrestling Room Wall Mats :
1. As shown and indicated on the contract drawings, all work necessary to provide wrestling wall mats in the wrestling room, including but not limited to materials, wall prep, site coordination, and install. See contract drawings for details.
- G. Alternate No. 7 - Wrestling Floor Mat :
1. As shown and indicated on the contract drawings, all work necessary to provide a new wrestling floor mat in the wrestling room, including but not limited to materials, floor prep, site coordination, and install. See contract drawings for details.
- H. Alternate No. 8 - LVT Flooring Instead of Rubber Track Flooring :
1. As shown and indicated on the contract drawings, provide alternate flooring finish at the rubber walking track, including but not limited to, materials, floor prep, site coordination, and install. See contract drawings for details.
- I. Alternate No. 9 - Data Cabling :
1. Material and labor to be included in as an alternate, including but not limited to jacks, wiring, data racks, patch panels, and testing to be included in project by the EC. Any

switches, routers, wireless access points, and fiberoptic patch panels are not in project scope and are to be owner provided if alternate is accepted.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 012500
SUBSTITUTION PROCEDURES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

- A. Instructions to Bidders.
- B. Section 012200 - Unit Prices, for additional unit price requirements.
- C. Section 016000 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.

1.03 DEFINITIONS

- A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
 - 2. Agrees to provide the same warranty for the substitution as for the specified product.
 - 3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
 - 4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
 - 5. Waives claims for additional costs or time extension that may subsequently become apparent.
- B. A Substitution Request for specified installer constitutes a representation that the submitter:
 - 1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.
- C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
- D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
 - 1. No specific form is required. Contractor's Substitution Request documentation must include the following:
 - a. Project Information:
 - 1) Official project name and number, and any additional required identifiers established in Contract Documents.
 - b. Substitution Request Information:
 - 1) Discrete and consecutive Substitution Request number, and descriptive subject/title.
 - 2) Indication of whether the substitution is for cause or convenience.
 - 3) Issue date.
 - 4) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
 - 5) Description of Substitution.
 - 6) Differences between proposed substitution and specified item.

- 7) Description of how proposed substitution affects other parts of work.
- c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
 - 1) Physical characteristics.
 - 2) In-service performance.
 - 3) Expected durability.
 - 4) Visual effect.
 - 5) Warranties.
 - 6) Other salient features and requirements.
 - 7) Include, as appropriate or requested, the following types of documentation:
 - (a) Product Data:
 - (b) Certificates, test, reports or similar qualification data.
 - (c) Drawings, when required to show impact on adjacent construction elements.
- d. Impact of Substitution:
 - 1) Savings to Owner for accepting substitution.
 - 2) Change to Contract Time due to accepting substitution.
- E. Limit each request to a single proposed substitution item.
 - 1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

- A. Submittal Time Restrictions:
 - 1. Instructions to Bidders specifies time restrictions and the documents required for submitting substitution requests during the bidding period.

3.03 RESOLUTION

- A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
- B. Substitution requests that are approved will be documented in the project addenda.

END OF SECTION

**PRIOR APPROVAL / SUBSTITUTION
REQUEST FORM**

Date: _____

Company Submitting Request: _____
(Name and Address)

Contact Name: _____ Phone: _____ Fax: _____

E-Mail: _____

PROJECT NAME: _____

SPECIFIED ITEM: _____
(Section) (Page) (Description)

The undersigned requests consideration of the following product substitution:

PROPOSED SUBSTITUTION: _____
Provide Product Name / Model /Manufacturer

1. Attached data includes: _____ Product Description _____ Performance and Test Data
_____ Drawings _____ Specifications _____
Photographs

2. _____ Yes / No changes will be required to the Contract Documents for the proper installation of proposed product substitution. If yes, then attach data that includes description of changes.

The undersigned states that the following paragraphs, unless modified by attachments, are correct:

1. The proposed substitution does not affect dimensions shown on the drawings.
2. No changes to the building design, engineering design, or detailing are required by the proposed substitution.
3. The proposed substitution will have no adverse effect on other trades, the construction schedule, or **specified warranty requirements.**
4. No maintenance is required by the proposed substitution other than that required for originally specified product.
5. Other Information

The undersigned further states that they have read the corresponding specification section in the project manual and confirms that the function, appearance and quality of the proposed substitution are equivalent or superior to the originally specified product._initial.

Signature: _____ Printed Name: _____

Fax Number: _____

For Architect's Use:

____ Accepted ____ Accepted As Noted ____ Incomplete Information

____ Not Accepted
This

____ Received Too Late

____ No Substitutions Accepted For
Product

Reviewed By / Date: _____

Processed by Addendum No. _____

Comments: _____

**SECTION 013000
ADMINISTRATIVE REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electronic document submittal service.
- B. Preconstruction meeting.
- C. Progress meetings.
- D. Submittals for review, information, and project closeout.
- E. Number of copies of submittals.
- F. Submittal procedures.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF) format and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
 - 1. Besides submittals for review, information, and closeout, this procedure applies to requests for information (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
 - 2. It is Contractor's responsibility to submit documents in PDF format.
 - 3. Users of the service need an email address, Internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
 - 4. Paper document transmittals will not be reviewed; emailed PDF documents will not be reviewed.
- B. Submittal Service: The selected service is:
 - 1. Submittal Exchange (tel: 1-800-714-0024): www.submittalexchange.com/#sle.

3.02 PRECONSTRUCTION MEETING

- A. Architect will schedule a meeting after Notice of Award.
- B. Attendance Required:
 - 1. Owner.
 - 2. Architect.
 - 3. Contractor.
- C. Agenda:
 - 1. Execution of Owner-Contractor Agreement.
 - 2. Submission of executed bonds and insurance certificates.
 - 3. Distribution of Contract Documents.
 - 4. Submission of list of Subcontractors, list of Products, schedule of values, and progress schedule.
 - 5. Designation of personnel representing the parties to Contract and .
 - 6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 - 7. Scheduling.
- D. Record minutes and distribute copies within two days after meeting to participants, with two

copies to Architect, Owner, participants, and those affected by decisions made.

3.03 PROGRESS MEETINGS

- A. Attendance Required:
 - 1. Contractor.
 - 2. Owner.
 - 3. Architect.
 - 4. Contractor's Superintendent.
 - 5. Major Subcontractors.
- B. Agenda:
 - 1. Review minutes of previous meetings.
 - 2. Review of Work progress.
 - 3. Field observations, problems, and decisions.
 - 4. Identification of problems that impede, or will impede, planned progress.
 - 5. Review of submittals schedule and status of submittals.
 - 6. Maintenance of progress schedule.
 - 7. Corrective measures to regain projected schedules.
 - 8. Planned progress during succeeding work period.
 - 9. Maintenance of quality and work standards.
 - 10. Effect of proposed changes on progress schedule and coordination.
 - 11. Other business relating to Work.
- C. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 CONSTRUCTION PROGRESS SCHEDULE - SEE SECTION 013216

- A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.

3.05 SUBMITTALS FOR REVIEW

- A. Submit to Architect for review for the limited purpose of checking for conformance with information given and the design concept expressed in the contract documents.
- B. Samples will be reviewed only for aesthetic, color, or finish selection.
- C. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 017800 - Closeout Submittals.
- D. Submit for Architect's knowledge as contract administrator or for Owner. No action will be taken.
- E. When the following are specified in individual sections, submit them at project closeout:

3.06 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

3.07 SUBMITTAL PROCEDURES

- A. Shop Drawing Procedures:
 - 1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting the Contract Documents and coordinating related Work.
 - 2. Generic, non-project specific information submitted as shop drawings do not meet the requirements for shop drawings.
- B. Transmit each submittal with a copy of approved submittal form.
- C. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.
- D. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number,

and specification section number, as appropriate on each copy.

- E. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of Products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with the requirements of the Work and Contract Documents.
- F. Schedule submittals to expedite the Project, and coordinate submission of related items.
- G. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
- H. Identify variations from Contract Documents and Product or system limitations that may be detrimental to successful performance of the completed Work.
- I. Provide space for Contractor and Architect review stamps.
- J. When revised for resubmission, identify all changes made since previous submission.
- K. Distribute reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with requirements.
- L. Submittals not requested will not be recognized or processed.

END OF SECTION

**SECTION 013216
CONSTRUCTION PROGRESS SCHEDULE**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preliminary schedule.
- B. Construction progress schedule, bar chart type.

1.02 SUBMITTALS

- A. Within 10 days after date of Agreement, submit preliminary schedule defining planned operations for the first 60 days of Work, with a general outline for remainder of Work.
- B. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- C. Within 10 days after joint review, submit complete schedule.
- D. Submit updated schedule with each Application for Payment.

1.03 SCHEDULE FORMAT

- A. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

- A. Prepare preliminary schedule in the form of a horizontal bar chart.

3.02 CONTENT

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification section number.
- C. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- D. Provide separate schedule of submittal dates for shop drawings, product data, and samples, owner-furnished products, and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.
- E. Indicate delivery dates for owner-furnished products.
- F. Provide legend for symbols and abbreviations used.

3.03 BAR CHARTS

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify the first work day of each week.

3.04 REVIEW AND EVALUATION OF SCHEDULE

- A. Participate in joint review and evaluation of schedule with Architect at each submittal.
- B. Evaluate project status to determine work behind schedule and work ahead of schedule.
- C. After review, revise as necessary as result of review, and resubmit within 10 days.

3.05 UPDATING SCHEDULE

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- C. Annotate diagrams to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other

identifiable changes.

- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit reports required to support recommended changes.

3.06 DISTRIBUTION OF SCHEDULE

- A. Distribute copies of updated schedules to Contractor's project site file, to subcontractors, suppliers, Architect, Owner, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections shown in schedules.

END OF SECTION

SECTION 01 32 23 SURVEY AND LAYOUT DATA

PART 1 GENERAL

1.01 GENERAL

- A. The requirements and provisions for engineering and layout of survey and layout data are as specified in the General Conditions and as supplemented herein.
- B. Topography and profiles showing existing ground elevations and culture were obtained by topographic survey.
- C. The Contractor shall hire the Engineer/Surveyor to furnish construction staking to prosecute the Work as described below. The Contractor shall make timely demands of the Engineer/Surveyor for such staking. The Contractor shall provide advance written notice of not less than three working days for setting stakes.
 1. Benchmarks for elevation will be provided in close proximity to site.
 2. Concrete sidewalk, concrete pavement, and concrete ramps & steps shall be staked at 20 foot intervals and at all changes in grade or line and will include radius stakes.
 3. The subgrade and base course for the parking lots and other areas shall be blue topped at an interval as agreed upon between the Engineer and the Contractor.
 4. The contractor shall be responsible for transferring from benchmarks, grade and line stakes all distances and elevations necessary for the execution of the work.
 5. The Contractor may request additional staking at the Pre-Construction Conference. Should the Contractor request the setting of stakes in excess of those described above, after the Pre-Construction Conference, the Contractor shall be responsible for the extra cost, which will be prorated on the basis of the total number of stakes set.
 6. **Electronic files can be made available for use with a Contractor's GPS system. Contractor will be responsible for the extra cost which Helms and Associates puts into preparing these files for their use and for any additional control points set by Helms and Associates personnel.**

- D. The Contractor shall preserve all construction stakes, reference points, and other survey points. In case of their loss or destruction, the Contractor shall be liable for and charged with the cost of their replacement and of any expense resulting from their loss or disturbance. Such surveys shall constitute instruction from the Engineer, and the Contractor shall not proceed with the Work until construction stakes have been provided.
- E. Should the Owner's representative be required to reset construction stakes, the cost for such resetting will be at the then current per diem rates. The charges for such Work will be deducted from the progress payments for the Contractor for the month in which the surveying Work is done by the Owner and thereon paid to the Owner's representative.

* * * END OF SECTION * * *

**SECTION 014000
QUALITY REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submittals.
- B. Control of installation.
- C. Testing and inspection agencies and services.
- D. Control of installation.
- E. Defect Assessment.

1.02 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
 - 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test/inspection.
 - h. Date of test/inspection.
 - i. Results of test/inspection.
 - j. Conformance with Contract Documents.
 - k. When requested by Architect, provide interpretation of results.

1.03 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. Owner will employ and pay for services of an independent testing agency to perform other specified testing.
- B. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

PART 3 EXECUTION

2.01 CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have Work performed by persons qualified to produce required and specified quality.
- F. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.

2.02 TESTING AND INSPECTION

- A. Testing Agency Duties:
 - 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 - 2. Perform specified sampling and testing of products in accordance with specified standards.
 - 3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 - 4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.
 - 5. Perform additional tests and inspections required by Architect.
 - 6. Submit reports of all tests/inspections specified.
- B. Limits on Testing/Inspection Agency Authority:
 - 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 - 2. Agency may not approve or accept any portion of the Work.
 - 3. Agency may not assume any duties of Contractor.
 - 4. Agency has no authority to stop the Work.
- C. Contractor Responsibilities:
 - 1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 - 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
 - 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested/inspected.
 - c. To facilitate tests/inspections.
 - d. To provide storage and curing of test samples.
 - 4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
 - 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 - 6. Arrange with Owner's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
- D. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
- E. Re-testing required because of non-compliance with specified requirements shall be paid for by Contractor.

2.03 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not conforming to specified requirements.

END OF SECTION

SECTION 01 45 23
QUALITY CONTROL – TESTING AND INSPECTING SERVICES

PART 1- GENERAL

1.1 WORK INCLUDED

- A. Extent of work of this section includes all labor, materials, equipment and services necessary for the testing of specific contractor installed materials in the Construction Documents.
- B. As the Testing Laboratory is not a Contractor; the normal services and agreements in the general conditions and bidding procedures do not apply. This section, governs the procedures.
 - 1. Testing Laboratory performance is governed by the laws of the **State of North Dakota**.
- C. Selection, payment and use of Testing Laboratory Services
 - 1. By providing a cost for the services described below directly to the owner, on the date of other bids, the Testing Laboratory shall be retained and paid for by the Owner, except as noted. The Testing Laboratory shall act in all matters relating to testing.
 - a. Contractors will not control the means or the methods of testing or inspections. Contractors must however provide scheduling information to the Testing Laboratory.
 - b. Testing agency will contact the Architect and Engineer for instructions on scope of the work, if necessary.
- D. It shall be the responsibility of the Testing Laboratory to familiarize themselves with all sections of the Contract Documents and the project schedule.
- E. All testing required of this project shall be performed by a single testing laboratory.
- F. The testing requirements shall remain in force for the full duration of the construction contract, including all delays or time extensions.
- G. Provide to the Contractor, contact information, list of items to be inspected and other information to assist the Contractor in scheduling his work, while allowing for inspections and tests of this section.
- H. Related Contract Documents.
 - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and remaining Division 00 and 01 Specification Sections as they apply to this section.

1.2 TESTING LABORATORY REQUIREMENTS OF COST AND ABILITY

- A. All testing laboratories desiring to provide their services for this project must submit for approval to the Owner, at the time and date of bid, for review by the Architect the following:
 - 1. Documentation that the Testing Laboratory meets requirements of the American Council of Independent Laboratories (ACIL).
 - 2. Provide documentation that the Testing Laboratory has an in-house quality assurance program.
 - 3. Proof that the Testing Laboratory is owned and directly managed by a Professional Engineer, licensed in the State where testing and inspections occur.
 - a. Principals of the Testing Laboratory and their project managers must be registered professional engineers with a minimum of five years experience in the types of testing required under this contract. Each person in charge of laboratory testing, field-testing and inspection must have not less than one's years experience in the duties performed under this contract and shall perform their duties only under the direct supervision of a registered professional engineer.

4. Total price of services for the project, as a bid, based on the scope of the work shown in this section and the laws of the state of South Dakota as they relate to professional engineering services.
 - a. Use Bid form provided in Project Manual.
 - b. This bid if made into a contract is not subject to retainage.
 - c. This bid is a lump sum made on the basis of a computation of unit prices for testing and observation services. At the end of this section a quantity of units in terms of hours and or specific activities is given. The bid provided shall be based on that information.

** The Quantity of tests required is part of the submittal by the Testing Laboratory to the Owner. (See end of Part 3)*
 - d. Provide a unit price for each hour or quantity asked for. These unit prices shall become the basis, if required, to provide additional testing services.

1.3 REFERENCES

- A. ANSI/ASTM E329 - Standard Practice for Use in the Evaluation of Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
- B. ASTM E543 - Practice for Determining the Qualifications of Agencies Performing Nondestructive Testing.
- C. ASTM E548 - Standard Guide for General Criteria Used for Evaluating Laboratory Competence.
- D. ASTM A802 – Standard Practice for examination of steel castings, surface acceptance and visual examination.
- E. ASTM E174 Standard Practice for Radiographic Examination.
- F. ASTM C1077 – Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
- G. ASTM C1093 - Practice for the Accreditation of Testing Agencies for Unit Masonry.
- H. ANSI/ASTM D3740 - Standard Recommended Practice for Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
- I. ASTM D4561 – Practice for quality control systems for an inspection and testing agency for bituminous paving materials.
- J. ASTM E699 – Practice for criteria for evaluation of agencies involved in testing, quality assurance, and evaluating building components in accordance with test methods promulgated by ASTM committee E6.
- L. ICBO Model Program for Special Inspection (excerpts).
- N. CASE-Council of American Structural Engineers.
- O. AIA Document A201 - General Conditions - 1997 Edition

1.4 RELATED SECTIONS

- A. Project specifications and plans for all items to be inspected.
- B. Schedule as shown in Division 01 in Project Specifications.
- C. Submittals section in Division 01 as shown in Project Specifications.
- D. Contract closeout section in Division 01 as shown in Project Specifications.
- E. Project meeting Section in Division 01 as written in Project Specifications.

1.5 REPORTS OF TESTING

- A. Written Reports: Submit all test reports to Owner, Architect and Engineer, within 72 hours after each test is completed. Contractor shall also be given a copy.
- B. Verbal Phone Reports: Testing Laboratory is to give immediate verbal notification, to the Owner, the Architect, and to Heyer Engineering, immediately of any irregularity, failure, or non-compliance of tested items to ensure all necessary retesting and/or replacement of materials with the least possible delay in progress of the work.

- C. Test Standards: Testing Laboratory shall furnish the Architect and Engineer upon request, one (1) copy of each standard (ASTM, AASHTO and AWS) referred to or which is pertinent to these specifications.
- D. All reports, written and verbal, must state clearly whether work inspected or tested is/is not in compliance with Contract Documents.

1.6 PAYMENT OF TESTING SERVICES

A. Initial services:

- 1. The Owner, will pay for all initial-testing services requested by and anticipated by this specification. Costs for all such testing services shall be included in a proposal submitted directly to the Owner through the Architect. See information in this section.
 - a. See form at end of this specification section 3 for the required testing units. These units in either hours or events will form the basis of the cost of testing laboratory services.
- 2. Owner will through the Architect issue a change order if additional services are required. These additional services must be agreed to in writing by the owner, the testing laboratory and the architect. Additional services will be based on unit prices submitted by the testing laboratory and listed at the end of this specification section.

B. Additional or re-testing:

- 1. When initial tests indicate non-compliance with the Contract Documents, all subsequent re-testing occasioned by the non-compliance shall be performed by the same Testing Laboratory and the costs thereof will be borne entirely by the **Contractor**. If needed the Owner, through the Architect, will deduct the amount of the re-testing from the Contractors pay request.

C. Contractor required specimens and tests not in this Specification Section.

- 1. Products and materials, such as concrete, masonry, mortar or proposed engineered fill, requiring a test report or a design done by a Professional Registered Engineer prior to use; shall be performed by the Contractor and are not a part of the cost of this section for the Testing Laboratory Services.
- 2. Mechanical balancing, adjusting, or startup of systems or motor startup by either Mechanical, Electrical, or Plumbing Contractors is not a part of this work.

1.7 NON COMPLIANCE WORK STOPPAGE

- A. The Testing Laboratory shall act as the Owner's agent in testing and inspections on items in this section to determine compliance with plans and specifications.
- B. The Testing Laboratory **shall further advise the Owner, the Architect and the Structural Engineer if the non-compliance should result in the Owner** stopping that type of work from being performed until corrective action or replacement is completed. Based on the following criteria:
 - 1. If additional work would be added to existing non-complying work, adding additional expense to the Contractor to remove.
 - 2. It is clear by the quality and status of the non-complying work that the Contractor will continue to produce substandard work.
 - 3. It is clear that the Contractor does not understand how the work is to be produced in a manner consistent with the Contract Documents.
 - 4. A required inspection by a governmental official cannot be done unless further work is stopped, or work needed to be inspected is in danger of being covered.
 - 5. Public or worker safety in the sole opinion, of the Testing Agency, would be compromised if the work continues.

1.8 LIMITS ON AUTHORITY

- A. Employment of the Testing Laboratory in no way relieves the Contractor of his obligation to perform work in accordance with requirements of Contract Documents.

- B. Inspection firm may not release, revoke, alter, or enlarge any requirements of the Contract Documents.
- C. Inspection firm may not approve or accept any portion of the work.
- D. Inspection firm may not assume any duties of the Contractor.
- E. As stated in Section 1.6 above, Owner, not Testing Laboratory, has authority to stop work.
- F. Mechanical balancing, adjusting or startup of systems or motor startup by either Mechanical, Electrical or Plumbing Contractors is not a part of this work.

1.9 CONTRACTOR SCHEDULING AND NOTIFICATION RESPONSIBILITY

A. Even though Contractor is not paying for the work of this section. He must perform the notification and scheduling of all Testing. Therefore Contractor shall:

- 1. Provide notification to the Testing Laboratory based on schedule of all work to be inspected. Inspections missed due to the Contractor not notifying Testing Laboratory shall require contractor dismantling and un-covering of in place work.
 - a. If this is not done, the Owner, will stop all construction at the contractor's expense until he receives the proper documentation that the tests were performed. Once the engineer has approved the criteria and testing results, the work may proceed.
- 2. The Testing Laboratory shall attend the pre-construction meeting and all other meetings during work that is to be inspected to familiarize themselves with the project, the contractors and the project schedule.
 - a. **The Contractor is responsible for the project schedule and for scheduling of all testing.**
- 3. When changes of construction schedule are necessary during construction, the Contractor shall make contact with the Testing Laboratory to determine such schedule changes.
 - a. The Testing Laboratory will not be held accountable for lack of inspection when a Contractor purposely covers portions of the work to be inspected.
- 4. Provide incidental labor and materials to provide access to work to be inspected. Such as having ladders, available scaffolding and other components readied and in the same safe condition as that available for they're own workmen.
- 5. Inspection or testing performed exclusively for a Contractor's convenience shall be the sole responsibility of the Contractor. This includes strength tests for OSHA or AWAIR.

1.10 TAKING SPECIMENS

- A. All specimens and samples for testing will be taken only by the Testing Laboratory; all sampling equipment and personnel will be provided by the Testing Laboratory; and all deliveries of specimens and samples to the Testing Laboratory will be performed only by the Testing Laboratory.
 - 1. The only exception for taking of specimens is that the Masonry Contractor may take his own mortar test cylinders. However they must be transported by the Testing Laboratory.
- B. Contractors shall provide representatives of the Testing Laboratory access to the work at all times in order that the Laboratory may properly perform its functions.

1.11 CODE COMPLIANCE TESTING

- A. Inspections and test required by codes or ordinances, or by a plan approval authority, not listed in Part 3 Execution, shall be the responsibility of and shall be paid for by the Contractor, unless otherwise provided in the Contract Documents.
 - 1. Contractor, not Testing Laboratory, is responsible for design of certain materials to be used in the field such as concrete and mortar mix designs and design of precast, wood and light gauge engineered assemblies and systems.

1.12 SPECIAL INSPECTIONS

- A. All requirements under the Special Inspections portion of the International Building Code are separate items not listed under this section. They however are required by the Owner of the Contractor.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 VIBRATION CONTROL (Not Used)

3.2 EXCAVATION & BACKFILLING (Includes Special Inspection per CASE and IBC 2018)

- A. The Testing Laboratory shall be on site to observe and monitor the mass site excavation and backfilling of the building structure area.
 - 1. Verify that all unsuitable organic materials, black and soft soils have been removed.
 - 2. Test the mass backfill and verify correct depth of material backfill lifts.
 - 3. After mass backfill is complete, monitor and verify the correction of secondary settlement and inform the Architect/Structural Engineer and General Contractor the readiness for footing excavation to begin.
- B. Inspect each footing and slab subgrade to determine if subgrade materials are acceptable. Perform hand auger borings and soil classifications. Make density tests to determine if the actual soil bearing values capacity complies with specified value.
- C. Test all engineered fill materials as to density and optimum moisture content. Per ASTM D698.
 - 1. Visit the site of the borrow pit or site and determine that anticipated values of sample are consistent with all materials to be used from the pit or site.
 - 2. Use values determined from tests to calibrate site compaction and soil density work.
- D. For footings or foundation walls. Take soil density and moisture tests at the site in all engineered fill areas. Test 4 corners of each 2000 s. f. or 2 locations in every 100 lineal foot of fill and backfill. This shall be done per every one foot of lift, of fill or backfill. Per Nuclear Density Method B in ASTM D2922 overall Basis.
- G. Slab on grade work includes the use of vapor barrier and a 6" granular cushion. Examine both prior to placement of reinforcing steel to determine that:
 - 1. All mechanical, electrical, underfloor drainage and or other below surface work are complete prior to installation of vapor barrier and or granular cushion. Do not allow placement until underground work is complete.
 - 2. All vapor barrier seams are overlapped a min. of 12 inches. Sides of vapor barrier are raised up 12" over the top level of slab and are attached to walls and that all seams are taped.
 - 3. The 6" granular fill is placed above the vapor barrier and the vapor barrier is not broken during placement.

3.3 GRADING FOR PARKING LOTS, DRIVEWAYS, APPROACHES

- A. Testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- B. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
 - 1. Paved Concrete or Asphalt Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area, but in no case fewer than three tests.
 - 2. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.4 ASPHALTIC CONCRETE

- A. Verify at batch plant that asphaltic formulation meets project specifications.
- B. Test aggregate base course for proper compaction and observe proof rolling for pumping.
 - 1. Aggregate base course must be compacted to not less than 100% Standard Proctor maximum dry density ASTM D698.
 - 2. Areas that are pumping must be cut out, relaid, recompact and proof rolled.
- A. Verify correct number of asphalt lifts are being laid.
- B. Take bituminous course tests at every 5000 sq. feet for bitumen content, gradation of aggregate, field density, air void content and thickness. **(All tests must be taken after laydown but prior to rolling or compaction.)**
 - 1. Test each course.
 - 2. Density must be 95% of Marshall density.
 - 3. Asphalt content by weight shall be 6.0 to 8.0% of the total mixture.
 - 4. Air void Content shall be 3-5% maximum as per ASTM 2041.
- C. Using surveying equipment and or lasers verify drainage of all paved areas after compaction and rolling. Drainage in all paved areas to be a minimum of ¼" per foot.
 - 1. Test at random 10'-0" areas so that surface is smooth to ¼" +/- in 10'-0" area.
All bird baths must be redone.

3.5 FORMWORK (Includes Special Inspection per CASE and IBC 2018)

- A. Verify formwork for all concrete will result in member size, location, and configuration as described on the contract documents, as it affects the structural integrity of the concrete elements to be placed.
 - 1. Measure distance between forms and reinforcing to determine proper coverage of reinforcing.
 - 2. Check for form oil or lubricants on reinforcing.
 - 3. Verify that formwork is properly tied and supported.

3.6 REINFORCING STEEL (Includes Special Inspection per CASE and IBC 2018)

- A. All steel bars must be positively identified as to heat number and mill analysis. Reports to be provided by the supplier. All reinforcing steel shall have a number assigned to it corresponding to the placement mark on the submittal.
 - 1. All steel bars that cannot be identified by heat number and mill analysis shall have one tensile and one bend test made for each 2-1/2 tons or fraction thereof, of each size and kind of reinforcing steel.
Testing procedure shall conform to ASTM A615.
- B. No reinforcing steel shall be placed without an approved shop drawing.
- C. The testing laboratory shall verify size and location of all bars prior to concrete placement.
 - 1. Verify that chairs or similar product have been provided and are in place for all slab reinforcement.
- D. A written report shall be submitted to the Engineer stating the results of the verification and any modifications required by the General Contractor to meet the plans and or specifications.

3.7 CONCRETE (Includes Special Inspection per CASE and IBC 2018)

- A. Portions of the following such as Engineered mix design are furnished by the installing Contractor; Testing of Concrete in the field is performed by the Testing Agency under the Owner.
- B. **After Contractors Mix design work is complete, field testing shall occur as follows:**
 - a. Contractor or Testing Lab shall perform slump tests and take strength test cylinders (minimum of 5) at the point of application, or after it has been pumped, during first day's work. If a plasticizer is being used, test before and after addition of plasticizer and so note on the test report. Non

compliant tests shall mean non-use of that trucks' product. All other days work shall be tested on every other truck after it has passed through the pumper.

- b. Air entrainment tests shall be taken in the same manner as the concrete slump tests **but shall be taken by the Testing Laboratory.**
2. If slump or air content falls outside specified limits another test shall be made immediately from another portion of same batch. If this test likewise fails, the concrete of that load shall be discarded and the truck carrying it shall not be allowed to unload at the site for 1 hour. Truck identification number shall be recorded if this procedure is necessary
3. Notify batch plant of mix irregularities and request materials and proportioning check
4. Use and reporting of Field Samples:
 - a. Testing Lab shall perform laboratory strength tests on actual concrete work. Provide a single cylinder 7 day test and a final 28 day test with an average of 3 test cylinders, Keep one additional cylinder as a field hold to be tested in cold weather or as needed. A total of 5 (five)-test cylinders are required. Contractor may keep additional cylinders for use in determining form removal timing and to verify OSHA strength requirements for steel columns. Take daily tests on every 50 yards of each type of concrete used.
 - b. Furnish certified compression test reports to Owner, Engineer, Architect and Concrete Contractor. On test report indicate following information:
 - Cylinder identification number and date cast.
 - Portion of structure and location of structure where tested
 - Type of concrete, slump and percent air.
 - Compressive strength of concrete in PSI.
 - Weather conditions during placing.
 - Temperature of concrete.
 - Maximum and minimum ambient temperature during placing.
 - Ambient temperature when concrete sample in test cylinder was taken.
 - Date delivered to laboratory and date tested.
 - Certification by the plant that the specified mix design and all required admixtures are included.
11. Verify thickness of concrete walls, slabs, raised slabs and other concrete work.
12. Verify that concrete meets FF and FL level and flatness standards listed in Section 03300 or 03300 Part 3 Execution The system is designed to measure 4' 20" x 20' test sections randomly chosen on the slab on grade and the raised deck floor not including stoops. The Sections should not adjoin each other unless the floor is less than 80'x 80' in size.
13. Verify that hot weather and or cold weather concrete installation requirements are being followed by the Contractor. If sufficient protections and methods are not being followed for the production, installation, protection and curing of concrete in cold weather or hot weather conditions, the pour must stop and only continue once conditions are remedied. See ACI 305R, ACI 306R.

3.8 STRUCTURAL STEEL BEAMS, COLUMNS, JOISTS AND GIRDERS(Includes Special Inspection per CASE and IBC 2018)

- A. Verify that anchor bolts and their setting pattern is at correct elevation, allows for 1-1/2" grout under the base plate and that pattern matches Contract Drawings and reviewed shop drawings.
- B. Welding:
 1. Field-welded connections shall be inspected visually.

- a. Fillet Welds - 50% of all connections, closely visually inspected as per AWS D1.1.
 - b. Partial Penetration - 50% of all connections, closely visually inspected as per AWS D1.1.
 - c. Full Penetration - 50 % of all connections, closely visually inspected as per AWS D1.1.
- 2. X ray testing of welded connections shall be required only if visual inspection determines that numerous (over 20%) flaws exist in the welding fillets and further visual inspection cannot be made to determine adequate welded connections.
- C. Bolted Connections: Per AISC, All bolted connections shall be bolted with ASTM A325, Type 1, 3/4" min. diameter bolts. All shear bolts at initial erection shall be snug fit tightened with a wrench.
 - 1. After final erection tightening and correction of plumb and square of steel; all shear bolt connections shall have the additional requirement of paint stick match marking. Paint shall mark the connection surface, the bolt, and the nut. A final 1/4" turn past snug fit with a wrench shall be required. Then the threads shall be welded or damaged
 - 2. Quantity of Bearing Connections inspected is: 20% of total number of connections. Each bolt in tested connection shall be tested for snug fit.
 - a. Retighten 100% of bolts in tested connection if any bolts within tested connections are not adequately tightened.
 - b. Retighten 100% of ALL bearing style connections if more than 10% of the tested connections contain bolts not adequately tightened.
 - c. Retest system as defined above, if system has to be re-erected.
 - 3. Steel members shall be inspected to plumb, square and level. The standards shall vary but in general shall be no more than 1/2" per 16'-0" individual member.

3.9 STEEL DECKING (Includes Special Inspection per CASE and IBC 2018)

- A. The decking shall be marked as to thickness and type
 - 1. Decking must be supplied free of oil or lubricating fluids.
 - 2. If decking is to be painted, it must be primed and free from rust or excess abrasion.
 - 3. If decking is to be galvanized, the galvanizing must be free from abraded areas and the galvanizing shall be well bonded to all surfaces.
- B. Certification of the welder shall be made for the type and thickness of decking to be installed.
- C. Prior to work commencing, the welder shall assemble and weld at least two samples of deck material to a base steel section simulating the framing with one weld each sample. Twist the deck sample with respect to the base until failure occurs. If the decking tests or if the welds on shearing in torsion show the proper fusion area, the welds are satisfactory.
- D. Inspection of all welds and placement of decking shall occur before any covering materials are applied. 50% of all welds shall be inspected.
 - 1. Any areas that show burn-through shall be removed and replaced.
 - 2. Adequate bearing on base steel sections shall be verified.
 - 3. All openings larger than 6" shall have steel channel backup and bracing.

3.10 MASONRY (Includes Special Inspection per CASE and IBC 2018)

- A. Quality Assurance
 - 1. Concrete Masonry Unit: For each type of concrete masonry unit indicated, verify compliance with ASTM C 90 and the strength required by design. Verification may be by reviewing certification from unit producer showing compliance.

2. Review field welder qualifications by certification or verify by retesting. Obtain welder certificates.
- B. Field Testing
1. Masonry Strength Testing
 - a. Verification Testing Frequency: Verification of masonry strength (f'm) will be performed at the beginning of masonry construction and during construction for each 5,000 square feet of wall area or portion thereof.
 - b. Mortar
 - i. As construction begins, verify the proportions of the site-prepared mortar mix comply with the requirements of ASTM C 270 for the type specified.
 - ii. Verify the proportions of materials in premixed or preblended mortar comply with the requirements of ASTM C 270 for the type specified as delivered to the site.
 - c. Grout
 - i. Prior to grouting, verify the proportions of site-prepared grout mix comply with the requirements of ASTM C 476 for each type of grout used.
 - ii. Verify the proportions of materials in premixed or preblended grout comply with the requirements of ASTM C 476 as delivered to the site.
 - iii. For grout pre-mixed at a batch plant or otherwise not prepared on site, grout shall be sampled and tested in accordance with ASTM C 1019. Prepare one set of grout samples for testing at seven days and two sets for testing at 28 days.
 - d. For each type of wall construction indicated for testing, test representative masonry prisms by methods of sampling and testing of ASTM C 1314, and as follows:
 - i. Prepare one set of prisms for testing at 7 days and one set for testing at 28 days.
 - ii. For concrete masonry prisms adhere to requirements as specified under preconstruction testing. Build prisms on job using same materials and methods as for wall construction. Store prisms in air at temperature not less than 65°F in a facility supplied by the contractor where they will be undisturbed for seven (7) days. After seven (7) days, transport to laboratory in a manner which will not disturb mortar bond.
 - iii. Cap each prism with suitable material to provide bearing surfaces on each end.
 - iv. The preparation of prisms shall be observed by the testing agency that will test the prisms.
 - e. Report test results in writing and in form specified under each test method, to Architect and Contractor, on same day tests are made.
 - f. Retests: Where prism tests indicate non-compliance with specified requirements, additional testing shall be performed at the frequency of two additional tests for each unsatisfactory test. The cost of such additional testing shall be the responsibility of the Contractor. Where retesting fails to indicate conformance with specified requirements, any masonry construction represented by unsatisfactory tests shall be removed and replaced with acceptable masonry construction.
 - g. Testing of Non-Shrink Grout for Base Plates and Bearing Plates
 - i. Compressive Strength Tests: Compressive strength of grout shall be determined by testing grout cubes according to the requirements of ASTM C 109 - Modified. Test one set of three cubes at one day, and one set of three cubes at 28 days.
 - ii. Frequency of Testing: One set of cubes (6 cubes) shall be made for every ten base plates and bearing plates or fraction thereof but not less than one set for each day's operation. One set of cubes shall be made for each day's operation of grouting wall panels.

- C. Field Inspection
1. Mortar Joints: As construction begins, verify that mortar joints are being prepared in accordance with these specifications and ACI 530.1/ASCE 6/TMS 602.
 2. Reinforcement and Connectors: Prior to grouting, verify the size, grade, type and placement of reinforcement and connectors is in compliance with specified requirements.
 3. Grouting: Prior to any grouting procedure, the grout space shall be inspected to verify that it is clean and that cleanouts, if required, are in place and conform to requirements. Verify through continuous inspection that the placement of grout is in compliance with the requirements of the contract specifications and ACI 530.1/ASCE 6/TMS 602.
 4. Anchors: Continuously inspect the installation of anchors including anchors of masonry to other structural members, frames, or construction verifying their type, size, location, and installation.
 5. Anchors: Periodically verify the type, size and location of anchors including anchors of masonry to other structural members, frames, or construction is in compliance with specified requirements.
 6. Anchors: Verify maximum anchor tightening torque for all post-installed anchors.
 7. Welding of Reinforcing Bars: Observe the welding of reinforcing bars.
 8. Installed items: Verify that installed flashing, weep holes, construction joints, control joints and wall vents are installed in accordance with specifications.

3.12 FINAL REPORTING

- A. At the conclusion of the work, required to be inspected by the Testing Laboratory, a written report in binder form with an index shall be submitted as a permanent record to the Owner through the Structural Engineer of all tests, logs, comments and written reports.

END OF SECTION

**SECTION 015000
TEMPORARY FACILITIES AND CONTROLS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary utilities.
- B. Temporary telecommunications services.
- C. Temporary sanitary facilities.
- D. Temporary Controls: Barriers, enclosures, and fencing.
- E. Security requirements.
- F. Vehicular access and parking.
- G. Waste removal facilities and services.
- H. Field offices.

1.02 TEMPORARY UTILITIES

- A. Owner will provide the following:
 - 1. Electrical power and metering, consisting of connection to existing facilities.
 - 2. Water supply, consisting of connection to existing facilities.

1.03 TELECOMMUNICATIONS SERVICES

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.

1.04 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
- B. Maintain daily in clean and sanitary condition.

1.05 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.06 FENCING

- A. Construction: Commercial grade chain link fence.
- B. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.07 EXTERIOR ENCLOSURES

- A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.08 SECURITY

- A. Provide security and facilities to protect Work, existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft. Job site security is the responsibility of the Contractor.

1.09 VEHICULAR ACCESS AND PARKING

- A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
- B. Coordinate access and haul routes with governing authorities and Owner.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide means of removing mud from vehicle wheels before entering streets.
- E. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

1.10 WASTE REMOVAL

- A. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- B. Provide containers with lids. Remove trash from site periodically.
- C. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- D. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.11 FIELD OFFICES

- A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
- C. Locate offices a minimum distance of 30 feet from existing and new structures.

1.12 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.
- B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.
- C. Clean and repair damage caused by installation or use of temporary work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 016000
PRODUCT REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Transportation, handling, storage and protection.
- B. Product option requirements.
- C. Substitution limitations and procedures.
- D. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 SUBMITTALS

- A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
- B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.02 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION PROCEDURES

- A. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents.
- B. A request for substitution constitutes a representation that the submitter:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 - 2. Agrees to provide the same warranty for the substitution as for the specified product.
 - 3. Agrees to coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
 - 4. Waives claims for additional costs or time extension that may subsequently become apparent.

3.02 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 STORAGE AND PROTECTION

- A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication.
- B. Store and protect products in accordance with manufacturers' instructions.
- C. Store with seals and labels intact and legible.
- D. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- E. For exterior storage of fabricated products, place on sloped supports above ground.
- F. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
- G. Comply with manufacturer's warranty conditions, if any.
- H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- I. Prevent contact with material that may cause corrosion, discoloration, or staining.
- J. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- K. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

**SECTION 017000
EXECUTION AND CLOSEOUT REQUIREMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Requirements for alterations work, including selective demolition, except removal, disposal, and/or remediation of hazardous materials and toxic substances.
- C. Pre-installation meetings.
- D. Cutting and patching.
- E. Surveying for laying out the work.
- F. Cleaning and protection.
- G. Starting of systems and equipment.
- H. Demonstration and instruction of Owner personnel.
- I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.

1.02 RELATED REQUIREMENTS

- A. Section 017900 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections

1.03 QUALIFICATIONS

1.04 PROJECT CONDITIONS

- A. Use of explosives is not permitted.
- B. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.

1.05 COORDINATION

- A. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Notify affected utility companies and comply with their requirements.
- C. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- D. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and clean-up of work of separate sections.
- G. After Owner occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 - 1. Review conditions of examination, preparation and installation procedures.
 - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

3.05 GENERAL INSTALLATION REQUIREMENTS

- A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and

existing record documents only.

1. Verify that construction and utility arrangements are as shown.
 2. Report discrepancies to Architect before disturbing existing installation.
 3. Beginning of alterations work constitutes acceptance of existing conditions.
- B. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
1. Where openings in exterior enclosure exist, provide construction to make exterior enclosure weatherproof.
 2. Insulate existing ducts or pipes that are exposed to outdoor ambient temperatures by alterations work.
- C. Remove existing work as indicated and as required to accomplish new work.
1. Remove items indicated on drawings.
 2. Relocate items indicated on drawings.
 3. Where new surface finishes are to be applied to existing work, perform removals, patch, and prepare existing surfaces as required to receive new finish; remove existing finish if necessary for successful application of new finish.
 4. Where new surface finishes are not specified or indicated, patch holes and damaged surfaces to match adjacent finished surfaces as closely as possible.
- D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove, relocate, and extend existing systems to accommodate new construction.
1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components; if necessary, modify installation to allow access or provide access panel.
 2. Where existing systems or equipment are not active and Contract Documents require reactivation, put back into operational condition; repair supply, distribution, and equipment as required.
 3. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - a. Disable existing systems only to make switchovers and connections; minimize duration of outages.
 - b. Provide temporary connections as required to maintain existing systems in service.
 4. Verify that abandoned services serve only abandoned facilities.
 5. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification; patch holes left by removal using materials specified for new construction.
- E. Protect existing work to remain.
1. Prevent movement of structure; provide shoring and bracing if necessary.
 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 3. Repair adjacent construction and finishes damaged during removal work.
- F. Adapt existing work to fit new work: Make as neat and smooth transition as possible.
- G. Patching: Where the existing surface is not indicated to be refinished, patch to match the surface finish that existed prior to cutting. Where the surface is indicated to be refinished, patch so that the substrate is ready for the new finish.
- H. Refinish existing surfaces as indicated:
1. Where rooms or spaces are indicated to be refinished, refinish all visible existing surfaces to remain to the specified condition for each material, with a neat transition to adjacent finishes.
 2. If mechanical or electrical work is exposed accidentally during the work, re-cover and refinish to match.

- I. Clean existing systems and equipment.
- J. Remove demolition debris and abandoned items from alterations areas and dispose of off-site; do not burn or bury.
- K. Do not begin new construction in alterations areas before demolition is complete.
- L. Comply with all other applicable requirements of this section.

3.07 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
- C. Perform whatever cutting and patching is necessary to:
 - 1. Complete the work.
 - 2. Fit products together to integrate with other work.
 - 3. Provide openings for penetration of mechanical, electrical, and other services.
 - 4. Match work that has been cut to adjacent work.
 - 5. Repair areas adjacent to cuts to required condition.
 - 6. Repair new work damaged by subsequent work.
 - 7. Remove samples of installed work for testing when requested.
 - 8. Remove and replace defective and non-conforming work.
- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
- E. Restore work with new products in accordance with requirements of Contract Documents.
- F. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- G. Patching:
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 - 2. Match color, texture, and appearance.
 - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.08 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.09 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.
- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

- F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.10 SYSTEM STARTUP

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- D. Verify that wiring and support components for equipment are complete and tested.
- E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- F. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.11 DEMONSTRATION AND INSTRUCTION

- A. See Section 017900 - Demonstration and Training.

3.12 ADJUSTING

- A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.13 FINAL CLEANING

- A. Use cleaning materials that are nonhazardous.
- B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- C. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- E. Clean filters of operating equipment.
- F. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
- G. Clean site; sweep paved areas, rake clean landscaped surfaces.
- H. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.14 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
- B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.
- C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.

- E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
- F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.
- G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.
- H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.15 MAINTENANCE

END OF SECTION

SECTION 01 73 29 CUTTING AND PATCHING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general requirements of the Contract including General and Supplementary Conditions and as supplemented herein shall apply to the Work covered by this Section.

1.02 SCOPE AND DESCRIPTION

- A. This section describes the necessary coordination, materials and labor associated with cutting and patching of completed Work or connection of specified Work to existing facilities.

1.03 SUBMITTALS

- A. Prior to cutting which may affect the structural integrity of any structure, facility or portion of the project, or Work of another Contractor, or completed Work or existing facilities, the Contractor shall submit written notice to the Engineer requesting consent to proceed with the cutting. The notice shall designate the location, date and time the Work will be exposed for observation, and cutting will be initiated and completed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. All materials for cutting and patching shall comply with the Specifications for the type of Work to be done.

PART 3 EXECUTION

3.01 GENERAL

- A. Cutting (including excavating), fitting or patching of Work shall be executed as required to:
1. Uncover Work to provide for installation of ill-timed Work.
 2. Remove and replace defective Work
 3. Install and properly fit specified Work in existing construction, facilities, or structures.
 4. Remove and replace Work not conforming to requirements of Contract-Legal Documents, Specifications, or Drawings.
 5. Remove samples of installed Work as specified for testing.
- B. The Work of another Contractor, Work already completed, or existing facilities shall not be cut without the consent of the Engineer.

3.02 INSPECTION

- A. Representatives of the Contractor, Owner, and Engineer shall, before starting Work on that portion of the project, inspect and record the existing conditions of Work, including elements subject to movement or damage during:
1. Cutting and patching
 2. Excavating and backfilling
- B. After uncovering the Work, the Contractor and Engineer shall inspect Work and note all conditions affecting installation of new products.

3.03 PREPARATION

- A. The Contractor shall be responsible for providing shoring, backing and support as required to maintain structural integrity of the Work, protect other work, and provide protection from the elements.

3.04 PERFORMANCE

- A. The fitting and adjustment of products and material shall be executed to provide a finished installation that will comply with specified tolerances and finishes.
- B. All cutting and demolition shall be executed by methods that will prevent damage to other Work, and will provide the proper surfaces to receive installation of repairs and new Work.

PART 4 MEASUREMENT AND PAYMENT

4.01 METHOD OF MEASUREMENT

- A. Cutting and patching is considered incidental Work with no separate measurement to be made.

4.02 BASIS OF PAYMENT

- A. The cost of cutting and patching to complete Work as specified and shown on the Drawings shall not be measured and paid directly but shall be considered incidental to the project as bid.

* * * END OF SECTION * * *

**SECTION 017800
CLOSEOUT SUBMITTALS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project Record Documents.
- B. Operation and Maintenance Data.
- C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

- A. Section 013000 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- B. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

- A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.
- B. Operation and Maintenance Data:
 - 1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
 - 2. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
 - 3. Submit two sets of revised final documents in final form within 10 days after final inspection.
- C. Warranties and Bonds:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
 - 2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 3 EXECUTION

- A. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:

2.02 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

2.03 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 - 1. Description of unit or system, and component parts.
 - 2. Identify function, normal operating characteristics, and limiting conditions.
 - 3. Include performance curves, with engineering data and tests.
 - 4. Complete nomenclature and model number of replaceable parts.

- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- D. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- E. Provide servicing and lubrication schedule, and list of lubricants required.
- F. Include manufacturer's printed operation and maintenance instructions.
- G. Include sequence of operation by controls manufacturer.
- H. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- I. Additional Requirements: As specified in individual product specification sections.

2.04 WARRANTIES AND BONDS

- A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.
- B. Verify that documents are in proper form, contain full information, and are notarized.
- C. Co-execute submittals when required.
- D. Retain warranties and bonds until time specified for submittal.

END OF SECTION

**SECTION 017900
DEMONSTRATION AND TRAINING**

PART 1 GENERAL

1.01 SUMMARY

- A. Demonstration of products and systems where indicated in specific specification sections.
- B. Training of Owner personnel in operation and maintenance is required for:
 - 1. All software-operated systems.
 - 2. HVAC systems and equipment.
 - 3. Plumbing equipment.
 - 4. Electrical systems and equipment.
 - 5. Items specified in individual product Sections.
- C. Training of Owner personnel in care, cleaning, maintenance, and repair is required for:
 - 1. Items specified in individual product Sections.

1.02 RELATED REQUIREMENTS

- A. Section 017800 - Closeout Submittals: Operation and maintenance manuals.
- B. Other Specification Sections: Additional requirements for demonstration and training.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Training Plan: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
 - 1. Submit to Architect for transmittal to Owner.
- C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
 - 1. Include applicable portion of O&M manuals.
 - 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
 - 3. Provide one extra copy of each training manual to be included with operation and maintenance data.

1.04 QUALITY ASSURANCE

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
 - 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
 - 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 DEMONSTRATION - GENERAL

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by Owner.
- B. Demonstration may be combined with Owner personnel training if applicable.
- C. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
 - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.
 - 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

- D. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
 - 1. Perform demonstrations not less than two weeks prior to Substantial Completion.

3.02 TRAINING - GENERAL

- A. Conduct training on-site unless otherwise indicated.
- B. Owner will provide classroom and seating at no cost to Contractor.
- C. Provide training in minimum two hour segments.
- D. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.
- E. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
 - 1. The location of the O&M manuals and procedures for use and preservation; backup copies.
 - 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
 - 3. Typical uses of the O&M manuals.
- F. Product- and System-Specific Training:
 - 1. Review the applicable O&M manuals.
 - 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
 - 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
 - 4. Provide hands-on training on all operational modes possible and preventive maintenance.
 - 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
 - 6. Discuss common troubleshooting problems and solutions.
 - 7. Discuss any peculiarities of equipment installation or operation.
 - 8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
 - 9. Review recommended tools and spare parts inventory suggestions of manufacturers.
 - 10. Review spare parts and tools required to be furnished by Contractor.
 - 11. Review spare parts suppliers and sources and procurement procedures.
- G. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

SECTION 02 01 00 MAINTENANCE OF EXISTING CONDITIONS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the contract, including General and Supplementary Conditions shall apply to the Work covered in this Section.

1.02 SCOPE

- A. This Section describes, but is not limited to, the relationship of the Project to existing underground utilities and the Work associated with the location, adjustment, and repair of underground utilities.
- B. The information and data relative to existing underground utilities are provided to assist the Contractor with the preparation of his bid. This information should not be used by the Contractor for reference during construction of the Work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL

- A. Existing underground utilities, as shown on the drawings, are located in accordance with available data, but locations may vary and cannot be guaranteed. The exact locations shall be determined by each Contractor as the Work proceeds. Excavation work shall be done carefully so as to avoid damaging the existing utilities and Work.
- B. Each Contractor shall provide for protection, temporary removal and replacement or relocation of obstructions as required for the performance of this Work required in these contract documents.
- C. Other obstructions not shown on the plans and requiring relocation shall be exposed by the Contractor without injury; or if injured, shall be repaired by Contractor at his expense. Removal of such obstruction or its relocation shall be made by the Contractor according to the provisions of the General Conditions.

3.02 UTILITY CONTACT

- A. Prior to Work in a specific area affecting underground utilities, the following individuals shall be notified as appropriate:
- B. All above utilities, excepting water, may be located utilizing the One Call Notification Center:
(Locate Phone Number) 1-800-781-7474
(Admin. Phone Number) 1-800-422-1242
- C. The failure of any utility to be present for any reason, at the Pre-Construction Conference, if held, shall not relieve the Contractor of any responsibility described herein.

3.03 UTILITY REPAIR:

- A. When an underground utility is exposed or damaged, the Contractor shall comply with the repair requirements of the affected utility.
- B. When an underground utility is exposed, the Contractor shall compact the backfill beneath the exposed utility before completion of the backfill operation.

3.04 SANITARY/STORM SEWER AND WATER MAIN SEPARATION:

- A. Horizontal Separation - Sewers shall be laid at least 10 feet (3.0 m) horizontally from any existing or

proposed watermain. The distance shall be measured edge to edge. In cases where it is not practical to maintain a 10 foot (3.0 m) separation, the Department may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the sewer closer to a watermain, provided that the watermain is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation so the bottom of the watermain is at least 18 inches above the top of the sewer.

- B. If it is impossible to obtain proper horizontal separation as described above, both the watermain and sewer shall be constructed of slip-on or mechanical joint pipe complying with public water supply design standards of the Department and be pressure tested in accordance with AWWA standards to assure water tightness before backfilling.

3.05 Vertical Separation

- A. Sewers Crossing Under Watermains - The sewer shall be laid to provide a minimum of 18 inches from the top of the sewer to the bottom of the watermain. The crossing shall be arranged so the sewer joints will be equidistant and as far as possible from the watermain.
- B. Sewers Crossing Over Watermains - Either the watermain or the sewermain must be encased in a watertight carrier pipe that extends 10 feet (3.0 m) on both sides of the crossing, measured perpendicular to the watermain. The carrier pipe shall be PVC, ABS, or HDPE, and the ends sealed with a rubber gasket or boot.
- C. Special Conditions - When it is impossible to obtain the proper horizontal and vertical separation as stipulated above, one of the following methods shall be specified:
- D. Water Pipe - The sewer shall be designed and constructed equal to water pipe and shall be pressure tested in accordance with AWWA standards prior to backfilling to assure water tightness; or;
- E. Carrier Pipe - Either the watermain or the sewermain may be encased in a watertight carrier pipe that extends 10 feet (3.0 m) on both sides of the crossing, measured perpendicular to the watermain. The carrier pipe shall be PVC, ABS, or HDPE, and the ends sealed with a rubber gasket or boot.

3.06 Storm Sewer Requirements:

- A. A reinforced concrete pipe (RCP) storm sewer may cross below a watermain with a separation of less than 18 inches or at any height above a watermain provided the joints on the RCP within 10 feet of either side of the watermain are assembled with:
- B. Preformed butyl rubber sealant meeting federal specification #SS-S-210A and AASHTO M 198, and each of these joints are encased with a minimum 2-foot wide by 6-inch thick concrete collar centered over the joint and reinforced with the equivalent steel area as that in the RCP. Encasement of the watermain will not be required when the RCP joints are collared within the 20-foot section.
- C. An O-ring that conforms to ASTM C 443 specifications. O-rings are manufactured for concrete pipe with diameters up to 18 inches.
- D. A strip of impermeable material held in place with stainless steel bands and tested to 5 psi prior to the storm sewer being put into use.
- E. There shall be at least a 10-foot horizontal separation between watermains and sanitary sewer forcemains. There shall be an 18-inch vertical separation at crossings as required in paragraphs B and C.

PART 4 MEASUREMENT AND PAYMENT

4.01 METHOD OF MEASUREMENT

- A. The cost to repair any underground utilities or other obstructions damaged by the Contractor's activities shall be considered incidental Work with no separate measurement made.

4.02 BASIS OF PAYMENT

- A. The cost to repair any underground utilities or other obstructions damaged by the Contractor's activities shall be considered incidental Work with no separate and payment to be made.

* * * END OF SECTION * * *

SECTION 024100 DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Selective demolition of built site elements.
- B. Selective demolition of building elements for alteration purposes.
- C. Abandonment and removal of existing utilities and utility structures.

1.02 RELATED REQUIREMENTS

- A. Section 011000 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 011000 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
- C. Section 015000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- D. Section 016000 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- E. Section 017000 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- F. Section 311000 - Site Clearing: Vegetation and existing debris removal.
- G. Section 312200 - Grading: Fill material for filling holes, pits, and excavations generated as a result of removal operations.
- H. Section 312323 - Fill: Filling holes, pits, and excavations generated as a result of removal operations.

1.03 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

PART 3 EXECUTION

2.01 SCOPE

- A. Remove portions of existing building as indicated on the contract drawings.
- B. Remove all paving and curbs as indicated on drawings .
- C. Remove concrete slabs on grade as indicated on drawings .
- D. Remove fences and gates, as indicated on drawings.
- E. Remove other items indicated, for salvage, relocation, and recycling.
- F. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as specified in Section 312200.

2.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with other requirements specified in Section 017000.
- B. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Use of explosives is not permitted.
 - 3. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 4. Provide, erect, and maintain temporary barriers and security devices.
 - 5. Conduct operations to minimize effects on and interference with adjacent structures and

- occupants.
- 6. Do not close or obstruct roadways or sidewalks without permit.
- 7. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
- 8. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- C. Do not begin removal until receipt of notification to proceed from Owner.
- D. Do not begin removal until built elements to be salvaged or relocated have been removed.
- E. Do not begin removal until vegetation to be relocated has been removed and specified measures have been taken to protect vegetation to remain.
- F. Protect existing structures and other elements that are not to be removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.
- G. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- H. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

2.03 EXISTING UTILITIES

- A. Coordinate work with utility companies; notify before starting work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone; identify and mark utilities to be subsequently reconnected, in same manner as other utilities to remain.

2.04 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Architect before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Maintain weatherproof exterior building enclosure except for interruptions required for replacement or modifications; take care to prevent water and humidity damage.
- C. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove items indicated on drawings.

- D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. Verify that abandoned services serve only abandoned facilities before removal.
 - 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.
- E. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch as specified for patching new work.

2.05 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Remove from site all materials not to be reused on site; do not burn or bury.
- C. Leave site in clean condition, ready for subsequent work.
- D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

**SECTION 030516
UNDERSLAB VAPOR BARRIER**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sheet vapor barrier under concrete slabs on grade.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Preparation of subgrade, granular fill, placement of concrete.

1.03 REFERENCE STANDARDS

- A. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs; 2018a.
- B. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs; 2017 (Reapproved 2023).

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturers' data on manufactured products.
- C. Test Data: Submit report of tests showing compliance with specified requirements.
- D. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Underslab Vapor Barrier:
 - 1. Water Vapor Permeance: Not more than 0.010 perms, maximum.
 - 2. Thickness: 15 mils.
 - 3. Basis of Design:
 - a. Stego Industries LLC; Stego Wrap Vapor Barrier (15-mil):
www.stegoindustries.com/#sle.
 - b. Vapor Block by Raven Industries.
 - c. Substitutions: See Section 016000 - Product Requirements.
- B. Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, etc., for sealing seams and penetrations in vapor barrier.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surface over which vapor barrier is to be installed is complete and ready before proceeding with installation of vapor barrier.

3.02 INSTALLATION

- A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.
- B. Install vapor barrier under interior slabs on grade; lap sheet over footings and seal to foundation walls.
- C. Lap joints minimum 6 inches.
- D. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.
- E. No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.
- F. Repair damaged vapor retarder before covering with other materials.

END OF SECTION

**SECTION 03 10 00
CONCRETE FORMING AND ACCESSORIES**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Forms for all cast in place concrete
- B. Form accessories.
- C. Stripping forms.
- D. Waterstops
- E. Formdeck for stoops
- F. Opening in forms for other effected work.
- G. Shoring and reshoring as required. See structural notes page and details.

1.2 RELATED CONTRACT DOCUMENTS

- A. Documents affecting work of this Section include, drawings and general provisions of Contract, all General and Supplementary Conditions and all other Division 0 and 1 Specification Section.

1.3 WORK INSTALLED BUT FURNISHED UNDER SECTIONS

- A. Section 05 12 00 - Structural Steel: Steel fabrications attached to form work.

1.4 RELATED WORK

- A. Section 03 20 00 - Concrete Reinforcement.
- B. Section 03 30 00 –Cast-In-Place Concrete.
- C. Section 05 12 00– Structural Steel

1.5 REFERENCES

- A. ACI 301 - Specifications for Structural Concrete for Buildings.
- B. ACI 315 - Details and Detailing of Concrete Reinforcement.
- C. ACI 318 – Building Code Requirements for Structural Concrete.
- D. ACI 350 - Code Requirements for Environmental Engineering Concrete Structures
- E. ACI 347 - Recommended Practice for Concrete Formwork.
- F. PS 1 - Construction and Industrial Plywood.
- G. ACI 117-Standard Specifications for Tolerances.

1.6 QUALITY ASSURANCE

- A. Construct and erect concrete form work in accordance with ACI 301.
- B. Tolerances:
 - 1. See ACI 117.

1.7 CONTRACTORS RESPONSIBILITY FOR FORMWORK DESIGN AND REMOVAL

- A. The form-work system shall be designed to support freshly place concrete and reinforcing materials, It shall transfer all concrete loads to the bearing soils or to completed construction in a safe manner at all times. Remove formwork, in a manner that does not damage the concrete or the elements of the project. Under the requirements of the construction documents, IBC, All local Building codes, ACI, OSHA and Local Workmen's Compensation; The contractor, and not the engineer or architect, shall provide engineering as required to meet this obligation.

PART 2 – PRODUCTS

2.1 FORM MATERIALS (Earth is not an approved forming material)(Conform to ACI 301 and ACI 347 for design, fabrication, erection and removal of forms.)

- A. Plywood: Douglas Fir or equal species; sound, undamaged sheets with straight edges, manufactured for concrete wall forms.
 - 1. Conform to Tables for form design in APA Form V-345, including strength.
- B. Glass Fiber Fabric Reinforced Plastic Forms: Matched tight fitting, stiffened to support weight of concrete without deflection detrimental to structural tolerances and appearance of finished concrete surface.
- C. Steel: Minimum 16 gauge sheet, well matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.
- D. Form deck: 1.5C 20 gauge (min) ASTM A653 by Vulcraft or equal, galvanized in accordance with ASTM 924-94 to a min class of G90, unless otherwise noted on plans.

- E. Circular pier or round column forms: Cardboard waxed or plasticized forms such as Sonotube or equivalent.
- F. Do not leave aluminum materials, which may cause a corrosive reaction, embedded in the concrete. Aluminum forms are acceptable.

2.2 FORMWORK ACCESSORIES

- A. Form Ties: factory fabricated, adjustable length, removable or snap off form ties which results in no metal being closer than 1 1/2" from surface of concrete when forms are removed.
- B. Form Release Agent: Colorless material that will not stain concrete, or absorb moisture.
 - 1. Do not allow form release agent to come in contact with reinforcing steel or inserts in the concrete.
- C. Fillets for Chamfered Corners: Wood strips or rigid plastic as detailed. 3/4" x 3/4".
- D. Nails, Spikes, Lag Bolts, Through Bolts, Anchorage's: Sized as required; of strength and character to maintain form work in place while placing concrete.
- E. Shelf Angle Inserts
 - 1. Wedge type inserts for 5/8" diameter bolts. Include horseshoe shims.
 - 2. Minimum capacity 2,100 pounds
- F. Dovetail Anchor Slots:
 - 1. 1" deep with 5/8" throat, 24 gauge galvanized steel.
- G. Flashing Reglets: 3/4" deep with 1/4" throat, 26 gauge galvanized steel.
- H. PVC weeps: 3" diameter PVC pipe.
- I. Waterstops: See plans and details for location.
 - 1. Extrudable non-leaching polyurethane products that will swell upon moisture contact.
 - a. Sika Products: SikaSwell S one part water swelled extruded polyurethane sealant, including special triangular shaped nozzle.
 - b. An equal approved product with one part polyurethane makeup that is free of bentonite or other leaching materials
 - 2. PVC Waterstop.
 - a. Unless otherwise noted within the construction documents, 4" Ribbed Center Bulb style shall be used at all cold formed joints in liquid bearing structures.
 - b. Waterstop shall have a minimum design head pressure capacity of 100' or greater.
 - c. PVC Waterstop must meet or exceed the performance required by U.S. Army Corps of Engineers Specification CRD-C 572-74.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Verify lines, levels, and measurements before proceeding with formwork.
- B. Depth or thickness of concrete being formed is to be as shown on plans. No variation in thickness or depth is allowed. (i.e.) a 4" slab is not to be poured at 3-5/8".

3.2 PREPARATION

- A. Arrange and assemble formwork to permit dismantling and stripping so that concrete is not damaged during its removal.
- B. Arrange forms to allow stripping without removal of principal shores, where required to remain in place.

3.3 ERECTION

- A. Provide bracing to ensure stability of formwork. Strengthen formwork liable to be overstressed by construction loads.
- B. Construct forms in accordance with ACI 301.

3.4 TOLERANCES

- A. Set and maintain forms to provide completed surfaces meeting the tolerances given in ACI 117. See Part 1 of these specifications.

1. Tolerances given in ACI 117 are not cumulative. Maximum tolerance for any formed surface, except footings, shall be one inch.

3.5 INSERTS, EMBEDDED PARTS, AND OPENINGS

- A. Provide formed openings where required for work embedded in or passing through concrete. Fill these voids with a readily removable material to prevent entry of concrete into voids or:
 1. Use void forming systems of correct size for openings required in the concrete. Follow manufacturers' instructions for proper strength ratings of void forms.
- B. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, including electrical boxes and conduit and other inserts.
 1. Ensure that forms will provide sufficient coverage for reinforcing. See Section 03200 for requirements.
- C. Install accessories in accordance with manufacturers' instructions level and plumb. Ensure items are not disturbed during concrete placement.
- D. Apply extruded waterstop in form locations as shown on plans and details. Form all joints as a continuous $\frac{3}{4}$ " bead strictly according to the manufacturer's instructions so that waterstops are continuous.
 1. Following manufacturers' instructions, use largest of the 2 precut triangular nozzles to insure proper form and size of bead. Apply to clean, dry flat surfaces.
 - a. Depending on concrete thickness more than one bead may be required. Consult manufacturer's instructions.
 2. Waterstop must be allowed to pass through all form bulkheads. Notch bulkheads at end of all pour intersections.
 - a. **To prevent waterstop damage**, install 2-3 hours prior to any concrete pour where vertical height is more than 20 inches. Use of a tremie to limit concrete drop to 20 inches is required if waterstop is less than 2 days old.
 - b. If wall is higher than 10'-0" contact Engineer for use of SikaSwell Hose.
- E. Build in dovetail anchor slots. Install anchor slots in concrete walls, columns, piers, beams and spandrels deeper than 14 inches and wider than 16 inches which will be in contact with masonry or elsewhere as indicated on the Drawings. Install anchor slots vertically, spaced 16 inches on center.

3.6 FORM RELEASE AGENT APPLICATION

- A. Apply agent on formwork only in accordance with manufacturer's instructions.
 1. Apply prior to installation of reinforcing steel, anchoring devices or embedments.
 2. If unable to completely remove agent from unintended items, replace the reinforcing steel, anchors or embedments.

3.7 FORM REMOVAL

- A. Replace concrete damaged by early removal of forms. Consult ACI 318, 301 and the following:
 1. Do not remove forms, shoring or bracing until concrete has sufficient strength to support its own weight, and construction and design loads that may be imposed upon it.
 2. Temperatures below 50 degrees F will prolong the timing of form removal.
- B. Form removal timing: Contractor shall verify the exact timing of form removal using these minimum removal times based on 28 day strength design of concrete and ACI 318.
 1. Footings: 24 hours minimum.
 2. 12" Walls under 5'-0" and 5'0" columns: 36 hours minimum.
 - a. For walls thicker than 12" and up to 20" add 8 hours.
 - b. For walls thicker than 20" same as 3 below.
 3. Walls and columns over 5'-0": 72 hours minimum but not until concrete, by cylinder test, has reached 50% of its 28-day design strength.

4. Beams, girders, raised decks or floors: 75% of its 28-day design strength. No time limit.
- C. Do not damage concrete surfaces during form removal.
- D. Reshoring: Reshoring is designed to allow concrete to deflect and support its own weight after initial set has occurred and forms have been removed. Remove forms and tightly place reshores only after initial concrete deflection. Do not remove reshores until concrete has reached its specified strength.
 1. Apply no construction loads or other loads to members being reshored
 2. Provide reshores for all two-way slabs until concrete reaches specified strength.
- E. At removal of forms patch all locations where wire ties protrude through the concrete or are exposed. Use primer and Non Shrink grout to solidly fill these holes. Also patch and grind to provide a smooth formed finish where required. See Part 1 of these specifications.

3.8 ALLOWABLE FACE & CORNER FINISHES

- A. Rough Form Finish: Concrete faces not exposed to view in the finished work shall have a rough form finish as defined by ACI 347.3.4 as a Class D finish. Holes shall be no larger than 3/8" and honeycombing or surface irregularities shall be no more than 1" in a 5'-0" area. However any exposed reinforcing steel or ties must be solidly grouted to match reinforcing coverage requirements.
- B. Smooth Form Finish: Concrete faces exposed to view in the finished work shall have a smooth form finish as defined by ACI 347.3.4 as a Class B surface. Class B surfaces have no more than 1/4" abrupt or gradual irregularities in a 5'-0" area and no holes larger than 1/4" on the surface. The contractor shall grind the surface where necessary to comply with these ACI requirements.
- C. Prominently exposed Class A finish: Concrete faces exposed to view as part of the architectural design or surfaces to receive finishes of any type (paint, textured paint, etc.) shall receive an class A smooth form finish as defined by ACI 347.3.4. These class A surfaces have no more than 1/8" abrupt or gradual irregularities in a 5'-0" area and no holes larger than 1/8" on the surface. The contractor shall then fill all holes and grind the exposed surface to provide a finish compatible with a heavily scrutinized surface.
- D. Corners not exposed to view may be formed either square or chamfered.
- E. Corners exposed to view shall be square, smooth, solid, unbroken lines except where a chamfered surface is called for on architectural plans
 1. Chamfered Corners shall be formed with chamfer strips to produce uniformly straight lines and tight edge joints. Unless otherwise stated the chamfers shall be 3/4" along both adjoining planes of the concrete edge. Extend the edges of the chamfers to the end of the formed surface. Match adjacent changes of direction by mitering to produce a connection without breaks in appearance. See architectural plans for where chamfers are required.

3.9 CLEANING

- A. Clean forms to remove foreign matter as erection proceeds.
- B. Ensure that water and debris drain to exterior through clean-out ports.

END OF SECTION

**SECTION 03 20 00
CONCRETE REINFORCING**

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Weldable and non-welded reinforcing steel bars, for cast-in-place concrete.
- B. Support chairs, bolster, bar supports, ties and spacers for supporting reinforcement.
- C. Adhesive installation of dowels and or bars into prior placed concrete, masonry or structure.

1.2 RELATED CONTRACT DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 0 and 1 Specification Sections apply to this Section

1.3 RELATED WORK

- A. Division 2 Earth and Site work.
- B. Section 03 10 00 - Concrete Forming and Accessories
- C. Section 03 30 00 – Cast-In-Place Concrete.
- D. Division 04 – Masonry
- E. Section 05 12 00 – Structural Steel

1.4 REFERENCES (Except where noted use latest edition)

- A. ACI 301 - Specification for Structural Concrete for Buildings.
- B. ACI 350 – Code Requirements For Environmental Engineering Concrete Structures
- C. ACI 318 – Building Code Requirements for Structural Concrete
- D. ACI 315 - Details and Detailing of Concrete Reinforcement.
- E. ANSI/ASTM A82 - Cold Drawn Steel Wire for Concrete Reinforcement.
- F. ANSI/ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.
- G. ASTM A 184/A - Welded Deformed Steel Bar Mats for Concrete Reinforcement.
- H. ANSI/AWS D1.4 - Structural Welding Code Reinforcing Steel.
- I. ASTM A615 – Standard Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
- J. ASTM A706 – Welding Bars for Concrete Reinforcement.
- K. CRSI - Manual of Practice.

1.5 QUALITY ASSURANCE

- A. Perform concrete reinforcement work in accordance with CRSI Manual of Standard Practice, and Documents 63 and 65.
- B. Conform to ACI.
- C. Have all reinforcing inspected by local authority and testing laboratory prior to concrete pour. See section 01 45 29.

1.6 SHOP DRAWINGS

- A. Submit shop drawings in no more or no less than 4 copies. Shop drawings shall show arrangement and layout, bending and assembly diagrams, bar schedules, stirrup spacing, splicing and laps of bars and shall be prepared in accordance with CRSI standards.
- B. Allow a minimum of 7 calendar days for processing not including shipping times.
- C. Provide layout with gridline coordinates and dimensions. Provide in accordance with ACI publication SP-66 / 315R-94 and 315-92 detailing manual.
 - 1. Provide cutting / bending lists and cut through concrete details that show all sizes, spacing, concrete cover, locations, splices and quantities of reinforcing steel.
 - a. Supporting devices are part of the work and must be shown on the submittal.

- D. Make a request in writing to Heyer Engineering to use portions of original design contract document drawings for layout of their submittal. If agreed, comply with the following:
- The title block, sheet numbers and all designers' stamps, signatures and references are removed and are never to be used by the fabricator or user.
 - Dimensions shown on contract documents are not verified and are not to be reused. Detailer shall create new dimensions from architectural contract documents for erection purposes. Gridlines only should be reused.
 - Non-reinforcing elements except for concrete or masonry shall be removed.
 - Details and elevations shown on contract documents are only for design and need to be completely redone by the detailer for erection purposes.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. Non Welded Reinforcing Steel: ASTM A615, 60 ksi yield grade billet-steel deformed bars, uncoated finish. Also includes smooth dowels. Use at all locations where A706 type is not specifically stated.
1. At construction joints, grease and wrap the exposed end portion of smooth dowels prior to next concrete pour.
 2. See Structural details for corner bar requirements in footings, foundations and masonry.
- B. Weldable Reinforcing Steel: ASTM A706 60 ksi yield grade low alloy steel deformed bars with uncoated finish. See locations required on plans and details.
- C. Welded Steel Wire Fabric: ASTM A185 plain type; uncoated finish. Where size not noted, use 6 x 6 W2.1 x W2.1.
1. Must be flat sheets only. Coils or wire rolls are not permitted.
- D. Reinforcing supports:
1. For footing, wall, pier or foundation supports use stirrups or wire meeting either CRSI Class 1-2 gauge tie wire meeting ASTM A82.
 2. Slab Reinforcing Supports: Use Stirrups, chairs, masonry materials, or concrete pre-placements meeting CRSI requirements. Wood materials are prohibited. Supports are to be furnished by material supplier unless masonry or concrete preplacements. Coordinate with contractor.

2.2 ACCESSORY MATERIALS

- A. Tie Wire: ASTM A82; minimum 16 gauge, annealed type, black.
- B. Adhesive Anchoring Products See Section 051200 for materials to be used when rebar must be embedded into existing structures.

2.3 FABRICATION

- A. Fabricate in accordance with ACI 315, providing concrete cover specified in this section.
- B. Locate reinforcing splices not indicated on Drawings at points of minimum stress. Indicate location of splices on shop drawings.
- C. If required in plans or details, weld reinforcing bars in accordance with ANSI/ASW D1.4.

2.4 JOBSITE STORAGE

- A. Reinforcing steel shall be stored at site on timbers or planks, not concrete, which will keep steel free from mud and water. If storage is during winter months cover and ventilate.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Prior to concrete placement all reinforcing shall be inspected by a Testing agency. See Section 01 45 29. This inspection shall verify that reinforcing is installed per the plans and specifications and is not contaminated with form lubricants. In case of a conflict between the plans and the submittal drawings promptly contact the Engineer for resolution.

- B. When the supporting medium is a raised platform inspect the platform or decking to insure that the substrate is the proper specified platform and that the finish of the deck is as specified.
- C. Prior to concrete placement, notify all required governmental authorities of the work to allow for their inspection and comment.
- D. Before placing concrete, clean reinforcement of foreign particles or coatings including form oils.

If reinforcement cannot be completely cleaned, replace contaminated reinforcement.

3.2 COVERAGE

- A. Maintain concrete cover around reinforcing as shown on structural plans and note sheet.

3.3 INSTALLATION

- A. For slabs and exterior walkways adjacent to building if reinforcement is not shown install 6 x 6 W2.1 x W2.1 flat sheet Woven Wire Fabric. Do not use coils.
- B. Place, support, and secure reinforcement against displacement. Do not deviate from alignment or measurement.
- C. Provide ties, bar supports and other permanent methods of keeping reinforcing steel at required position in the concrete.
 - 1. Anchor bolts or dowels for structure above footings or foundations may be placed in the top of initial pour prior to set of that concrete pour, within 30 minutes. They must be placed correctly and have all concrete at the area of the insertion hand troweled to provide a smooth and level top of concrete surface.
 - 2. Retaining walls, however, must have all elements including anchor bolts or dowels placed and supported in the initial pour.
- D. Chair up all steel bar slab reinforcing. Do not allow reinforcing to be at bottom of slabs. The process of lifting up bars during slab pouring is not permitted unless it is to lift it up onto pins or chairs, during pour, for permanent placement.
 - 1. Slabs where bars are not properly placed shall be replaced at contractors' expense.
- E. Where smooth dowel construction joints are utilized, grease and wrap one end of the dowel.
- F. See plans and details for specific locations that call for weldable reinforcing steel. At these locations use A706 reinforcing steel.
- G. For drilling or placing bolts, rods, anchors or similar embedments into existing masonry or concrete whether vertical or horizontal use an adhesive anchorage system. See Section 05121 for products to use and temperature restrictions. Substrate must not be below 32^oF.
- H. For masonry see placement details for horizontal, corner and vertical bars in masonry cores, bond beams, jambs and lintels on structural drawing sheets.

END OF SECTION

**SECTION 03 30 00
CAST-IN-PLACE CONCRETE**

PART 1 - GENERAL

1.1 RELATED CONTRACT DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 00 and 01 Specification Sections apply to this section.

1.2 WORK INCLUDED

- A. Furnish and install all cast-in-place concrete for footings, foundations, piers, columns, exterior stoops, interior slab on grade and raised slabs, equipment pads and other work as shown on plans and details.
 - 1. Equipment pads and similar concrete items. Division 15 and 16 contractors are responsible only for dimension, location and layout of the pads. Contractor of this section shall furnish and install concrete. If pad is located on top of a precast or other raised deck, provide information to the general contractor to adjust deck load prior to manufacturer's design of deck.
- B. Protection of freshly poured and concrete undergoing curing.
- C. Shelters, heat and weather protection of Cast in Place Concrete.
- D. Pumping of Concrete materials if required.
- E. Water stops. (See section 03 10 00).
- F. Installation of metal angles, embeds and anchor bolts furnished by Division 5 into the concrete.
- G. Core fill grouting of masonry (installed by mason)
- H. Precast Concrete grout (installed by precast erector).
- I. Precast Topping (installed by this concrete contractor).
- J. Admixtures, curing compounds and accessories.
- K. Sawcutting control joints.
- L. ASTM and ACI standards of level and flatness.
- M. Grouting of all control and construction joints with cementitious products compatible with flooring glues prior to flooring installation.

1.3 RELATED WORK

- A. Division 02- Earthwork
- B. Section 03 10 00 - Concrete Forming and Accessories
- C. Section 03 20 00 - Concrete Reinforcing
- D. Section 04 20 00 – Masonry
- E. Section 05 12 00 – Structural Steel Framing
- F. Section 05 31 00 – Steel Decking

1.4 REFERENCES (Use latest publication date unless otherwise noted)

- A. ACI 301 – Standard Specifications for structural concrete for buildings. (THE FIELD GUIDE)
- B. ACI 315 – Details and Detailing of Concrete Reinforcement
- C. ACI 318 – Building code requirements for structural concrete
- D. ACI 350 – Code Requirements For Environmental Engineering Concrete Structures
- E. ASTM C33 - Concrete aggregates.
- F. ASTM C618 – Standard specification for coal fly ash- type C. Use Coal Creek brand of fly ash only.
- G. ASTM C94 - Ready-Mixed concrete.

- H. ASTM C150 - Portland cement.
- I. ASTM C260 - Air-Entraining admixtures for concrete.
- J. ASTM C494 - Chemical admixtures for concrete.
- K. ASTM C309 – Curing compounds for concrete.
- L. ACI 210-Guide to durable concrete.
- M. ASTM C171- Specification for sheet material for curing concrete.
- N. ASTM E1155 – Standard test method for determining (FF) Floor flatness and (FL) Floor levelness numbers.
- O. ACI C308 - Standard practice for curing concrete.
- P. ACI C305R – Hot weather concrete work.
- Q. ACI C306R – Cold weather concrete work.
- R. AASHTO M-148 for curing materials.
- S. ASTM C192- Test methods for concrete.
- T. ASTM C156 - Test method for moisture retention for concrete.
- U. ASTM C 295 - Petrographic examination of aggregates for concrete.

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with ACI 301.
- B. Have a current copy of ACI 301 on the jobsite for reference during the work of this section.
- C. Dimensions as shown on Construction Drawings are as intended. Slabs listed as 4" shall be 4".
- D. If the Concrete provided does not meet these specifications, The Contractors' Independent Engineering & Testing Agency shall perform batch inspections for the design mix and shall sample and test mix ingredients until concrete quality is established to the satisfaction of these specifications.

1.6 DESIGN & TESTING

Submit the design mixes 10 days prior to placing concrete. Receive Engineers' review prior to use. Mix designs shall be no more than one-year-old from the date they are to be used. The following information shall be provided for each design mix.

- (1) Fine and coarse aggregate gradations per ASTM C33.
- (2) Method of determination the mix design proportions.
- (3) Water/cement ratio.
- (4) Entrained and non-entrained air content of freshly poured concrete.
- (5) Compressive strength at 28 days per ASTM C 39.
- (6) Chloride ion content of the concrete per ASTM C1218.
- (7) The proportions and types of all cementitious materials and admixtures.
- (8) The Shale and deleterious contents of all aggregates used.
- (9) Slump. Including slump both prior and after introduction of plasticizers; if they are used.
- (10) Location where concrete is to be placed. (i.e.) footings, topping etc.
- B. After design mix is approved, the testing and analysis of jobsite delivered concrete will be performed under provisions of Section 01 45 23including:
 - 1. Strength tests: 4 Cylinders (1-7day, average of 2-28 day, 1 field hold) per every 50 yards of each type of concrete for each days pour.
 - a. Contractor shall keep and test additional cylinders for use in his determination of form removal timing, for cold or hot weather verification and for OSHA required column strengths.
 - 2. Slump tests at the point of application and before and after addition of plasticizer.

Send back non-compliant trucks.

3. Air entrainment tests at same time as slump tests. Air tests in fresh concrete are intended to show current air content. Send back non-compliant trucks.
- D. Vehicles on which non-compliant concrete are delivered shall not be allowed to modify concrete to be in compliance. Vehicle shall return to redi-mix plant & offload non-compliant concrete prior to batching of new concrete. No rebatched, formerly rejected concrete shall be used.

1.7 SUBMITTALS

- A. Shop Drawings
 1. Construction Joints: Submit drawings of proposed construction joint locations in concrete for slab-on-grade, walls and foundations. Submit any additional or changed reinforcing that is required at construction joints that differs from that shown on drawings.
 2. Openings, Sleeves, and Cores: Submit drawings of all openings to be formed, sleeved, cored, or sawcut in cast-in-place elements. Drawings shall indicate size and location of openings, sleeves, or cores.
 3. Embedded Items: Submit drawing showing all items to be embedded in concrete elements, including plates, angles, bolts and any non-structural items such as conduit. Drawings shall indicate locations, size, orientation and type of embedded item.
 4. Anchor Rods: Submit drawings showing layout and details for steel templates used for placing anchor rods.

PART 2 – PRODUCTS

2.1 CONCRETE PROPERTIES, MATERIALS & MIXING

- A. Concrete shall be plant redi-mix type meeting ASTM C94. Site mixed concrete is not acceptable.
- B. Proportion mixes in accordance with ACI 211.1.
- C. Compressive strength (ASTM C31) and C39): See Chart for individual requirements.
- D. Water: potable, clean and free of injurious quantities of substances known to be harmful to and conforming to ASTM C94.
 1. Water / cement ratio: To be calculated for each mixed design. See Chart for individual basic requirements
 2. Maximum water to cement ratio for exterior concrete subject to freeze thaw cycles shall be 0.45. Use 8.32 lbs. per gallon.
- E. Portland Cement: ASTM C 150, Type I / II or Type I. All shall be low Alkali. If acid resistance is needed use type II. If high early strength is required use type III or add a minimum of 47 lbs. to each mix. Each bag is 94 lbs.
 1. Use the minimum quantity to reach desired 28-day compressive strength +15% overage.
- F. Type C Fly Ash, meeting ASTM C618. Maximum allowable percentage and allowable time of use is stated in Chart in Article 2.6.
- G. Fine aggregate: clean, durable and sound natural sand conforming to ASTM C33, #4 and down.
 1. Shale or deleterious content shall be no more than .5% for slabs and 1% for all other concrete.
- H. Course aggregate: clean, durable and sound natural processed gravel conforming to ASTM C33 and free of materials that can cause Alkali-silica reaction (ASR). See chart in Part 2 for maximum sizes.
 1. Shale or deleterious content shall be no more than .5% for slabs and 1% for all other concrete.

2. Maximum size shall not exceed 33 1/3% of the depth of any slab section.
3. Test course aggregate for ASR under ASTM C295 or ASTM C1260.
- I. Air content: Tested to ASTM C231. See chart in Part 2 for required fresh entrained quantities. All concrete has some non-entrained air.
- J. Slump: Tested to ASTM C 143. See chart in Part 2 for requirements.

2.2 COMMON CONCRETE ACCESSORIES AND ADDITIVES

- A. No products containing calcium chloride in a content of more than 0.06% of the cement weight in chloride ions or Thiocyanates will be permitted. See ASTM C494 and ACI 318. - **If additional admixtures are used after mix approval, notify the Structural Engineer.**
 1. Use an exterior curing compound for all exterior horizontal and exposed vertical surfaces.
Product shall meet ASTM C309 Type 2, Class B. These products leave a white Dye.
 2. Clear interior cure and seal products are required for interior slab concrete, where no floor covering or coating will be applied; they must meet ASTM C1315 type 2.
 - a. Verify that no floor covering or finish exists with Architect.
 3. On interior slabs on grade or raised placed in an enclosed temperature controlled building where floor covering will be adhered. Use a resin type, dissipating concrete curing compound meeting AASHTO M-148, and ASTM C309 Type I Class B. Verify that product shall penetrate and not leave material on surface.
 4. Wet curing materials for interior slab on grade or raised slab work where building has not been erected and concrete is exposed.
 - a. Burlap, cotton mats and rags, rugs or similar material under polyethylene sheets. Fabric must not have been previously used for sugar, fertilizer or acidic materials storage. Take care that material does not have dye which will stain the concrete. The material shall meet AASHTO M-147 and ASTM C156.
 - b. Combination poly and cloth sheets meeting ASTM C156.
 5. Performed expansion and wall isolation joint Filler: Non extruded type joint filler constructed of asphalt impregnated fibers meeting ASTM D1751. Material shall be full depth of slab of edge joint and exposed width shall be 1/2".
 6. Super plasticizer. Meeting ASTM C494F: For workability or for pumping the contractor may use a High Range Water Reducing Admixture/ or Super Plasticizer to go to a max. temporary slump of 6. Water must not be used to obtain this increase.
 7. Mid Range Plasticizer. Meeting ASTM C494 Type D: Combination water reducer and agent to improve workability for concrete during placement, at a level less than a superplasticizer.
 8. Water reducing admixtures: Water reducing admixtures meet ASTM C494, Type A.
 9. Air Entraining: Tests to ASTM C231. Air content is shown on chart in Part 2 for individual types of concrete. Air entraining products must meet ASTM C260. All concrete does have some non-entrained air.
 - a. Adjust if using a super or midrange plasticizer.
 10. Concrete Bonding Agents: If concrete is to be placed on top of existing concrete or masonry use products meeting ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
 11. Non-Chloride Accelerating Admixtures: If a faster initial set up is desired, or is specified in chart, use products meeting ASTM C 494 Type C. Never use chlorides.

2.3 GROUT FOR STRUCTURAL METAL BASEPLATES AND DOWELS

- A. See Section 05 12 00 for non-shrink non-metallic grout.

B. Grout for dowels, See section 05 12 00 for adhesive anchoring systems.

2.4 GROUT FOR INTERIOR CONTROL JOINT, COLD JOINTS, CRACKS OR EXPANSION JOINT FILLING

- A. Fill All Control Joints, construction joints and cracks over 1/16" in width except exterior required to prior to flooring or colorant installation
1. Use a cementitious thin patch that can be applied from featheredge to 1" inch thick. Products must contain at least 80% ASTM C150 cementitious materials. Product shall self-bonding to clean dry concrete and meet ASTM C1157 performance and ASTM C191 for material set characteristics. Some of these require flooring glues to be applied within 24 hours.

2.5 CONCRETE MIXING AND TRANSPORTING

- A. Do not add water to concrete at the site except with the direct written approval of the Structural Engineer or Architect. Delivery trucks shall deliver with minimum drum revolutions. No concrete older than 90 minutes from time of mixing in the truck shall be used for the project. See Article 1.6 on non-complaint concrete trucks.

2.6 CONCRETE MATERIALS, TYPES, STRENGTHS AND ADDITIVES

- A. Install mixes that provide following minimum requirements:
1. Concrete design mixes shall have a min. 15% over-design of compressive strength.
 3. Type C fly ash from Coal Creek Station in Stanton, North Dakota may be used up to the maximum percentages shown in non-cold weather conditions. Do not use fly ash within 48 hours prior to or 72 hours after an air temperature of 50 degrees or lower exists. Do not use from November 1st till April 15th where concrete is not in a 28-day environment where the temperature is kept above 50°. Fly ash will retard initial set.
- **Footings & Footing Pads**
 - Low Alkali Cementitious Product Types: Portland Type I or I/II
Maximum 25% Fly Ash Allowed
 - Maximum Aggregate Size: 1½"
 - Max Slump: 5"
 - 28 Day Compressive Strength: 3,000psi
 - Max w/c Ratio: 0.55
 - Allowed Admixtures; Air Entrainment: WRDA Series upon Approval
Use of Entrained Air is Contractors Option
 - **Foundation Walls, Columns, Piers, Grade Beams (IF NOT Exposed to Weather)**
 - Low Alkali Cementitious Product Types: Portland Type I or I/II
Maximum 20% Fly Ash Allowed
 - Maximum Aggregate Size: ¾"
 - Max Slump: 4"
 - 28 Day Compressive Strength: 4,500psi
 - Max w/c Ratio: 0.53
 - Allowed Admixtures; Air Entrainment: WRDA Series upon Approval
Mid-Range Plasticizer With Prior Approval
Use of Entrained Air is Contractors Option
 - **Foundation Walls, Columns, Piers, Grade Beams (IF Exposed to Weather)**
 - Low Alkali Cementitious Product Types: Portland Type I or I/II
Maximum 20% Fly Ash Allowed
 - Maximum Aggregate Size: ¾"
 - Max Slump: 4"
 - 28 Day Compressive Strength: 4,500psi
 - Max w/c Ratio: 0.45
 - Allowed Admixtures; Air Entrainment: WRDA Series upon Approval
Mid-Range Plasticizer OK

Super Plasticizer With Prior Approval
5%-7% Entrained Air

- **Interior Slabs on Grade and Metal Form Deck**
 - Low Alkali Cementitious Product Types: Portland Type I or I/II
Maximum 20% Fly Ash Allowed (Will Retard Initial Set)
 - Maximum Aggregate Size: 3/4"
 - Max Slump: 5"
 - 28 Day Compressive Strength: 4,000psi
 - Max w/c Ratio: 0.45
 - Allowed Admixtures; Air Entrainment: WRDA Series upon Approval
Mid-Range Plasticizer With Prior Approval
Super Plasticizer With Prior Approval
5% Entrained Air is Contractors Option

- **Exterior Horizontal Concrete on Grade and Metal Form Deck**
 - Low Alkali Cementitious Product Types: Portland Type I or I/II
Maximum 25% Fly Ash Allowed
Use min. 564 Lbs. of Cementitious Materials
 - Maximum Aggregate Size: 3/4"
 - Max Slump: 4"
 - 28 Day Compressive Strength: 4,500psi
 - Max w/c Ratio: 0.44
 - Allowed Admixtures; Air Entrainment: WRDA Series upon Approval
Mid-Range Plasticizer OK
Super Plasticizer With Prior Approval
5%-7% Entrained Air

- **Grout for CMU Wall Core Fill and CMU Bond Beams**
 - Low Alkali Cementitious Product Types: Portland Type I
Maximum 25% Fly Ash Allowed
 - Maximum Aggregate Size: 3/8" and min. 70% Fine Aggregate
 - Max Slump: 8"
 - 28 Day Compressive Strength: 3,000psi
 - Max w/c Ratio: 0.60
 - Allowed Admixtures; Air Entrainment: WRDA Series upon Approval
Mid-Range Plasticizer OK
Super Plasticizer is Prohibited
5% Entrained Air is Contractors Option

2.7 RELATED PRODUCTS

- A. Post-Installed Anchors.
 - 1. Mechanical Anchors: Only anchors having passed Acceptance Criteria 193 for use in cracked concrete and resisting wind and seismic loads shall be approved for use. Reports from the following organizations are acceptable:
 - a. ICC Evaluation Service Report.
 - b. IAPMO Uniform Evaluation Services.
 - 2. Adhesive Anchoring Systems: Only adhesive anchor systems that comply with the latest revision of ICC-ES Acceptance Criteria 308 for use in cracked concrete and resisting wind and seismic loads shall be approved for use. Reports from the following organizations are acceptable:
 - a. ICC Evaluation Service Report.
 - b. IAPMO Uniform Evaluation Services.
 - 3. Cold Weather Placement: See ACI 306R
- B. Anchor Rods:

1. ASTM F1554, Grade 36
- C. Non-Shrink Grout:
1. Type: Grout for base plates, bearing plates and grouting under precast or tilt-up wall panels shall be a non-metallic, shrinkage resistant, premixed, non-corrosive, non-staining product containing Portland cement, silica sands, shrinkage compensating agents and fluidity improving compounds.
 2. Specifications: Non-shrink grout shall conform to ASTM C 1107.
 3. Compressive Strength: Provide the minimum strength as shown below as determined by grout cube tests at 28 days:
 - a. 6,000 PSI for supporting concrete 3,000 PSI and less.
 - b. 8,000 PSI for supporting concrete greater than 3,000 PSI and less than or equal to 4,000 PSI.
 - c. Unless noted otherwise on the drawings, grout strength on supporting concrete greater than 4,000 PSI shall be 8,000 PSI.

PART 3 – EXECUTION

3.1 INSPECTION AND PROTECTION

- A. Notify Engineer minimum 24 hours prior to commencement of concrete placement.
- B. Verify anchors, seats, plates, reinforcement, drains and other items to be cast into concrete are accurately placed, held securely, and will not cause hardship in placing concrete. Provide written verification as well as photographs of the area to be poured.
- C. Insure polyurethane waterstops have been installed for at least 3 hours prior to pour and that rigid waterstop types are continually supported.
- D. Work area and Concrete may be exposed to potentially hazardous damage after initial set has been achieved. Take measures to protect concrete from traffic, ladders, fluids and indentation during initial set and curing. Ladders and all materials with sharp edges must have protective plywood under the rungs or edges.

3.2 PREPARATION

- A. Prepare existing concrete or masonry, for additional concrete by cleaning with steel brush and a neutral pH cleaning solution to insure removal of existing solvents, greases, plant products and other solutions. Apply an ASTM C1059 bonding agent in accordance with manufacturer's instructions.
- B. If concrete is to be placed on top of metal platforms, or decks, prepare metal surface by cleaning with an acid etching solution or vinegar. Do not place concrete if rust or oxidation is present. Notify Architect.
- C. If concrete is a slab to be placed on top of soil, insure that the soil is well compacted to specifications shown in earthwork section and that no debris or organic materials are present. Dampen the surface with water but do not flood.
- D. At any location where new concrete is doveled to existing work, use an adhesive anchoring system. See section 05 12 00.
- E. Protect and tape over all surfaces to be exposed, of all floor drains, openings and devices to be set into the concrete.
- F. Protect all concrete from freezing during placement and initial set. Under no circumstances can concrete be placed on top of frozen soil, snow, ice, and frozen precast or any other frozen object.

3.3 VAPOR RETARDER

- A. For all interior Slab on Grade Concrete with flooring or a finish applied; A vapor retarder shall be placed directly above granular subbase.
- B. Use screed bars and platforms and means / methods keep vapor retarder unbroken.

3.4 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301. Keep an ACI 301 book on site for reference at

all times.

1. Do not allow a vertical drop of more than 5'-0" without use of a Tremie to prevent aggregate segregation.
 2. Hot Weather Placement: See ACI 305R
 3. Cold Weather Placement: See ACI 306R
- B. Ensure reinforcement, inserts, embedded parts, drains and formed joints are not disturbed during concrete placement. If movement occurs the concrete contractor must remove and replace the effected item and the effected concrete.
- C. See section 03 20 00 and structural notes sheet for minimum concrete cover.
- D. Use a minimum 1/8" per foot slope for all floor drains. Pitch entire room slab or maximum area of 20'- 0" and increase to 1/4" per foot of pitch in final 4'-0" of space around the drain. The concrete shall be worked well around all surfaces of the drain fitting.
- E. All slab reinforcing must be on chairs. Hand lifting without supports during pour is prohibited.
- F. Place concrete continuously between predetermined construction and control joints. Do not break or interrupt successive pours that would cause new cold joints to occur.
- G. Excessive honeycombing or embedded debris in concrete is not acceptable. Contractor must replace or repair. See section 03 10 00, Part 3 for acceptable finishes.
- H. Concrete may be placed by means of a Concrete pumper. A plasticizer and a decrease in course aggregate size may be used only with permission of the Engineer when pumping is used. Cementitious content will need to be raised if aggregate size is modified. See requirements on slump and super plasticizer in Part 2.
- I. The concrete shall be screeded or struck off slightly above final elevation, then consolidated.
1. Consolidate concrete by vibrating, so that concrete is thoroughly worked around reinforcement, around embedded items and into corners of forms to eliminate air or stone packers that may cause honeycombing, pitting or weakness.
 - a. Vibrating shall be done by experienced workers in a manner to eliminate consolidation. Do not vibrate forms or reinforcing materials.
 2. After consolidation the concrete shall not be further worked until finishing.
- J. Do not add water during placement or when finishing.
- K. Depth or thickness of concrete is to be as shown on the plans. No variation in thickness or depth is allowed.
1. Slab concrete that is shown as 4 inches shall not be formed and poured at 3 5/8".
- L. Do not use cement or sand to take up excess surface water.

3.5 HORIZONTAL SURFACE FINISHING (Including interior & exterior floors)

- A. Finish the concrete when the water sheen has disappeared and the surface has stiffened enough to permit the finishing operation. Follow ACI 302.1R.
- B. Types of final finishes are:
1. For all interior flat exposed, resilient tile, or thin set ceramic tile covered floors float and then "Hard Steel Trowel Finish" the concrete surface in accordance with finishing class 5. This is designed to provide a smooth floor. Provide very close surface tolerances and no telegraphing of cementitious surfaces into the tile.
 - a. Use the same finish for carpet covered floors.
 2. For all interior floors that will have ceramic or material requiring a grout bed provide only a floated finish with a wood float surface that allows for a level but not perfectly smooth surface. Considered a class 1,2 or 3 surface, but without any final troweling.
 3. For all interior concrete that contains air entrainment of 3% or less, an aluminum or magnesium float followed by a "Hard Steel Trowel Finish" shall be applied. Class 2.
 4. For all exterior concrete that contains air entrainment, an aluminum or magnesium

float followed by a "Light Soft Bristle Broom Finish" shall be applied.

5. For all interior concrete that requires slip resistance, an aluminum or magnesium float, followed by minimal steel trowling for levelness and a "Light Soft Bristle Broom Finish" shall be applied.
 6. See ACI 302.1R for class 6 and higher floors that are impact, high traffic or super flat.
- B. All concrete horizontal surfaces, including floors must be flat and level. The following chart shows ASTM E1155 values in an average commercial situation for a flat and level floor that shall be followed:
1. F_F defines the maximum floor curvature allowed over successive 24" measurements on a 20'-0" x 20'-0" floor or flat surface. It is concerned with floor waviness.
 2. F_L defines the maximum difference in elevations in decimals of an inch, between two points separated by 10'-0" taken any place on the floor. It is concerned with local levelness.
 3. The specified overall numbers are the maximum obtainable.
 4. The minimum localized numbers are the required expected values for the test section.
- C. A traditional method to determine floor flat and levelness is to place a 10'-0" flat level anywhere on the surface. No more than a 3/16" gap would be measured under the level at any place on the floor or interior or exterior surface. In the chart we have listed this traditional measurement **as a guide only.**
- D. The ASTM system is designed to measure 4 20' x 20' test sections randomly chosen on the floor or surface in question. The Sections should not adjoin each other unless the floor is less than 80'x 80' in size.

Types of concrete Horizontal surfaces & Their Quality Classifications	Minimum FF / FL		Numbers Required	Local Levelness Value	Maximum Clearance Under a 10' Level
	Overall Flatness Value	Local Flatness Value	Overall Levelness Value		
Flat concrete base for grout bed	20	15	15	10	3/8"
Precast Topping Surface	30	20	15	10	3/16"
Raised Slab Surface	30	20	15	10	3/16"
Interior Slab on Grade surface	35	24	30	20	1 / 8"
Exterior & garage floors, stoops, paving surfaces	20	15	13	10	1 / 4"

3.6 CRACKS, EXPANSION, CONSTRUCTION, AND CONTRACTION JOINTS

- A. Horizontal and vertical construction joints in concrete shall be made only where shown for structural drawings and or approved by Engineer. All cold construction joints shall be provided with a suitable bonding agent at all grooves and keyways, and surfaces against which new concrete is to be laid shall be thoroughly cleaned with a stiff wire brush and water.
1. Where smooth dowel construction (cold) joints are used, grease and wrap the exposed end of the dowel to allow horizontal movement.
- B. Expansion joints at edges of the building or bay shall be filled with expansion material to within 3/4" of top of all adjacent slabs or edges and shall be located where shown on drawings. See Part 2 products for types of materials to use.

- C. Control joints shall be saw cut and located as shown on structural drawings. If not shown cut at intervals of (36 x slab thickness)" by (36 x slab thickness)" (+/- 5'-0"). Locate under wall partitions if possible.
 - 1. Saw cut control joints at an optimum time after finishing. Use 3/16-inch thick blade, cutting at least 1/4 into depth of slab thickness. (i.e.) 4" slab to be cut 1"+ deep. Fill saw cut control joint with a semi rigid joint filler, in accordance with ACI301, section 11.3.9. General Contractor is responsible for joint and semi rigid joint filler condition up to 90 days after building is occupied. After the 90 days, owner is responsible for joint maintenance.
- D. All exposed joints and cracks over 1/16" in interior concrete upon which flooring or colorants are to be applied shall be grouted solid with a cementitious grout acceptable to flooring glue manufacturer. Contractor shall install prior to flooring installation but after initial cracking and movement due to shrinkage is complete. Generally 28 days. See part 2 products for material to use. Coordinate with flooring work. Some products have a limited time for installation of flooring.
 - 1. All joints that are under walls or partitions or are unexposed shall be sealed with a semi rigid joint filler, in accordance with ACI 301, section 11.3.9.

3.7 CONCRETE CURING AND SEALING (See also ACI 308)

- A. All interior and exterior concrete must be kept between 55 and 80 degrees F and in a moist condition, to decrease water evaporation from the exposed surfaces during the first 7 days after placement.
 - 1. For building or shelter-enclosed concrete, Contractor may use temporary heaters provided that he vent all flue gases from units to the outside of the enclosure. Use only fresh outside air for combustion. All heaters of this type must also be equipped with a heat exchanger vented to the outside.
- B. All interior slabs receiving glued down flooring, either on grade or raised, that are enclosed by the building shall be kept between 55° and 80° F and cured in the following manner.
 - 1. Either use the method in Paragraph C.1. below or:
 - 2. After finish troweling apply a resin based dissipating cure product meeting ASTM C309 with no surface residue in a double cross coat application. This will provide moisture retention only. Keep foot and equipment traffic off the slab for 7 days. Use products that do not leave residue on slab surface. See Part 2 Products.
 - 3. **Do not apply to concrete that will have colorant or exposed aggregate.**
- C. All interior slabs, receiving glued down flooring either on grade or raised **that are exposed to weather and not enclosed** by the building during concrete pour and cure shall be kept between 55° and 80° F and cured in the following manner.
 - 1. Cover the slab with wet, non-ink containing burlap or similar material, under a 4-mil thick polyethylene plastic sheeting or a combination burlap / polyethylene cloth to retain moisture. Keep burlap or similar material moist and the slab cured in this manner for 7 days at a temperature range of 55 to 70 degrees F.
 - 2. Install materials to hold down the material.
 - 3. If high early strength, Type III, concrete is used and temperature is kept above 73 degrees the period of time of wet curing required may be reduced to 3 days.
- D. Allow the surface of the concrete to further cure and dry for a period of 28 days prior to exposure to epoxy finishes, flooring glues, hard surface traffic, steel wheels or shovels.
- E. All exterior exposed uncolored vertical or horizontal concrete shall have a white dye release curing compound meeting ASTM C309 Type 2 applied.
 - 1. See Part 2 Products and follow manufacturer recommendations & limitations for their use.
- F. All interior slabs, left uncovered and not receiving any finish, colorant or flooring, either on grade or raised shall have a curing and sealing compound meeting either ASTM C1315 Type 1 or C309 Type 1 applied.
 - 1. See Part 2 Products for type and Architectural Plans for locations.
- G. **Interior athletic or vehicle traffic** use uncolored or covered concrete slabs shall have an exterior cure and seal compound meeting ASTM C1315 Type 2 applied. See Part 2 Products for type and Architectural Plans for locations.

3.8 GROUTING OF CORES IN MASONRY UNITS

- A. Fill all cells containing reinforcing with grout once masonry units have reached sufficient strength to resist grout pressure.
 - 1. Grout masonry units in a height that allows full access to each lift's cores. Generally no more than 4'-0" in height each lift.
 - 2. If core fill grout is to be placed in more than one lift, depress level of grout in first row of cells by 2" inches to insure an adequate bond on the following upper masonry layer.
 - 3. At the top surface of the masonry stack bond, strike off any excess material above the surface.
 - 4. At the top surface of the masonry stack bond, strike off any excess material above the surface.
 - B. Keep cells to be filled clean.
 - C. Center metal bars and dowels in the cells.
 - D. Vibrate if necessary to ensure grout has reached entire depth of cell.
- 3.9 SETTING AND GROUTING OF STRUCTURAL METALS AND BASEPLATES**
- A. See section 05 12 00.
 - B. Setting of anchor bolts is by this 03 30 00 Section using template, Contract Drawings and reviewed shop drawings from Section 05 12 00.
- 3.10 TOPPING CONCRETE**
- A. Install after all precast is set, all welding is complete and grouting is cured and reached its 28-day strength. (Topping is supplied and installed by this concrete contractor)
- 3.11 GROUTING OF PRECAST CONCRETE UNITS** (Grout is installed by precast erector)
- A. After all erection, bolting and welding of precast units and placement of reinforcing is completed, grout shall be placed. All edges of plank, columns or beams and all metal supports connections or embedments must be grouted full and shall match the level of the adjacent surface. (Grout is supplied and installed by the precast erector.)
 - 1. See heating and covering requirements in 03 41 00 any time temperature of air is below 55F.
 - 2. During summer comply with hot weather precautions stated in ACI 305R.
- 3.12 FOOTING & FOUNDATION CONCRETE**
- A. Do not use earth forms for footings.
 - B. Insure that all forms are braced sufficiently to handle weight and shifting from pouring of concrete.
 - C. Have an inspection done of all footings prior to pouring this concrete. Correct any reinforcement or form deficiencies prior to pouring. Do not imbed horizontal or cross bracing reinforcing after concrete has been poured. Dowels may be set after pouring but must be placed while concrete is still wet and pliable not after initial set. Drilling in dowels after set is not acceptable.
 - D. Use vibration to insure that all concrete is solidly placed and that no voids or honeycombs are allowed to occur.
 - E. Insure that top of footing concrete is level and able to receive masonry or concrete foundations without excessive dips or void areas.
 - F. Keep forms in place until the concrete is sufficiently strong enough to avoid deflection. See Section 031000.
 - G. During backfilling operations, brace foundation walls to prevent flexural distortion in curing concrete.
- 3.13 EXTERIOR CONCRETE**
- A. Insure that surface is not frozen on which concrete is to be poured. Protect finished product from freezing temperatures. See ACI 306 R.
 - B. If concrete is placed in hot weather in temperature above 80 degrees, provide protection to all newly poured surfaces. See ACI 305R.
 - C. Keep traffic off concrete until 75% of minimum required strength is attained by test.
 - D. Follow ADA and local governmental requirements with regard to maintaining proper slope at pedestrian walkways.
 - E. Provide a gradual slope to catch basins, drains and similar.
 - F. Provide rounded surface to all edges of walks, drives or other horizontal concrete during

finishing. Provide a light broom finish to all horizontal exposed surfaces.

G. See Part 3 horizontal surface finishing for methods of curing and finishing exterior surfaces.

3.14 DEFECTIVE CONCRETE (See Chapter 9 of ACI 301)

A. Modify or replace concrete not conforming to required levels and lines, thickness, details, and elevations.

B. Repair or replace concrete not properly placed, indented or damaged, not of the specified type, frozen, spalling, under strength by more than 15%, or improperly cured. Testing agency that designed concrete, Engineer and Architect shall be final arbiters of quality.

3.15 FIELD QUALITY CONTROL

A. See Division 01 and Part 1 of this specification

3.16 CLEANUP

A. At completion of each day's work, remove all concrete spillage and splash from adjacent areas and work.

1. If Glass has been effected carefully, remove particles using methods approved by the glazing manufacturer. Do not use products that could etch glass.

2. Provide a disposal place for ready mix truck wash down. Do not allow wash down concrete to be deposited in the street, on finished landscaping or onto other work. Costs of cleanup of improperly disposed of wash down will be deducted from future payment and will include replacement of damaged or soiled property.

END OF SECTION

**SECTION 033511
CONCRETE FLOOR FINISHES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface treatments for concrete floors and slabs.
- B. Liquid densifiers and hardeners.

1.02 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with concrete floor placement and concrete floor curing.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
- C. Maintenance Data: Provide data on maintenance and renewal of applied finishes.
- D. Specimen Warranty: Manufacturer warranty.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.05 FIELD CONDITIONS

- A. Maintain light level equivalent to a minimum 200 W light source at 8 feet above the floor surface over each 20 foot square area of floor being finished.
- B. Do not finish floors until interior heating system is operational.
- C. Maintain ambient temperature of 50 degrees F minimum.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Correct defective work within a two-year period commencing on the Date of Substantial Completion.
- C. Finish Warranty: Provide five-year manufacturer warranty against excessive degradation of finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 DENSIFIERS AND HARDENERS

- A. Liquid Densifier and Hardener: Penetrating chemical compound that reacts with concrete, filling the pores, hardening, and dustproofing.
 - 1. Composition: Sodium silicate.
 - a. Products:
 - 1) Basis of Design: Curecrete Distribution, Inc; Ashford Formula: www.curecrete.com/#sle.
 - 2) Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that floor surfaces are acceptable to receive the work of this section.
- B. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.02 GENERAL

- A. Apply materials in accordance with manufacturer's instructions.

3.03 COATING APPLICATION

- A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
- B. Verify that water vapor emission from concrete and relative humidity in concrete are within limits established by coating manufacturer.
- C. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.
- D. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.

END OF SECTION

**SECTION 042000
UNIT MASONRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete Block.
- B. Mortar and Grout.
- C. Reinforcement and Anchorage.
- D. Flashings.
- E. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 055000 - Metal Fabrications: Loose steel lintels.
- B. Section 061000 - Rough Carpentry: Nailing strips built into masonry.
- C. Section 079200 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

- A. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2016.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- C. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement 2020.
- D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.
- E. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete 2018a.
- F. ASTM C91/C91M - Standard Specification for Masonry Cement 2018.
- G. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar 2018.
- H. ASTM C150/C150M - Standard Specification for Portland Cement 2020.
- I. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale) 2019.
- J. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2019.
- K. ASTM C404 - Standard Specification for Aggregates for Masonry Grout 2018.
- L. ASTM C476 - Standard Specification for Grout for Masonry 2020.
- M. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls 2017.
- N. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2016.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by all relevant installers.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, and masonry accessories.
- C. Samples: Submit panel samples of facing brick units to illustrate color, texture, and extremes of color range.
- D. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

- A. Comply with provisions of TMS 402/602, except where exceeded by requirements of the contract documents.

1.07 MOCK-UP

- A. Construct a masonry wall as a mock-up panel sized 4 feet long by 4 feet high; include mortar, accessories, and flashings (with lap joint, corner, and end dam) in mock-up.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

PART 2 PRODUCTS

2.01 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
 - 2. Load-Bearing Units: ASTM C90, normal weight.
 - a. Hollow block, as indicated.
 - b. Exposed Faces: Manufacturer's standard color and texture where indicated.

2.02 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91/C91M, Type N.
- B. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.
 - 1. Not more than 0.60 percent alkali.
- C. Mortar Aggregate: ASTM C144.
- D. Grout Aggregate: ASTM C404.
- E. Water: Clean and potable.

2.03 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers of Joint Reinforcement and Anchors:
 - 1. Blok-Lok Limited: www.blok-lok.com/#sle.
 - 2. Hohmann & Barnard, Inc; 2-Seal Tie: www.h-b.com/#sle.
 - 3. WIRE-BOND: www.wirebond.com/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- B. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed billet bars; galvanized.
- C. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- D. Single Wythe Joint Reinforcement: Truss or ladder type; ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M, Class 3; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.
- E. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A 153/A 153M, Class B.
 - 1. Anchor plates: Not less than 0.075 inch thick, designed for fastening to structural backup through sheathing by two fasteners; provide design with legs that penetrate sheathing and insulation to provide positive anchorage.
 - 2. Wire ties: Manufacturer's standard shape, 0.1875 inch thick.
 - 3. Vertical adjustment: Not less than 3-1/2 inches.
- F. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws; corrosion resistant finish or hot dip galvanized to ASTM A153/A153M.

2.04 FLASHINGS

- A. Copper/Kraft Paper Flashings: 3 oz/sq ft sheet copper bonded to fiber reinforced asphalt treated Kraft paper.
 - 1. Manufacturers:
 - a. Hohmann & Barnard, Inc: www.h-b.com/#sle.

- b. Substitutions: See Section 016000 - Product Requirements.
- B. Stainless Steel Flashing: ASTM A666, Type 304, soft temper; 26 gage, 0.0187 inch thick; finish 2B to 2D.

2.05 ACCESSORIES

- A. Preformed Control Joints: Rubber material. Provide with corner and tee accessories, fused joints.
 - 1. Manufacturers:
 - a. Blok-Lok Limited: www.blok-lok.com/#sle.
 - b. Hohmann & Barnard, Inc: www.h-b.com/#sle.
 - c. WIRE-BOND: www.wirebond.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- B. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
 - 1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
 - a. Manufacturers:
 - 1) Advanced Building Products Inc; Mortar Break DT: www.advancedflashing.com/#sle.
 - 2) Mortar Net Solutions: www.mortarnet.com.
 - 3) Substitutions: See Section 016000 - Product Requirements.
- C. Termination Bars: Stainless steel; compatible with membrane and adhesives.
- D. Drip Edge: Stainless steel; compatible with membrane and adhesives.
- E. Type: Polyester mesh.
- F. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.06 MORTAR AND GROUT MIXES

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
 - 1. Exterior, non-loadbearing masonry: Type N.
 - 2. Interior, loadbearing masonry: Type N.
 - 3. Interior, non-loadbearing masonry: Type O.
- B. Grout: ASTM C476; consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
- C. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
- D. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.02 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.
- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COLD AND HOT WEATHER REQUIREMENTS

- A. Maintain materials and surrounding air temperature to minimum 40 degrees F prior to, during, and 48 hours after completion of masonry work.
- B. Maintain materials and surrounding air temperature to maximum 90 degrees F prior to, during, and 48 hours after completion of masonry work.

3.04 COURSING

- A. Establish lines, levels, and coursing indicated. Protect from displacement.

- B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.
- C. Concrete Masonry Units:
 - 1. Bond: Running.
 - 2. Coursing: One unit and one mortar joint to equal 8 inches.
 - 3. Mortar Joints: Concave.
- D. Brick Units:
 - 1. Bond: Stacked.
 - 2. Coursing: Two units and two mortar joints to equal 8 inches.
 - 3. Mortar Joints: Concave.

3.05 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Remove excess mortar and mortar smears as work progresses.
- D. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
- E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- G. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- H. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

3.06 WEEPS/CAVITY VENTS

- A. Install weeps in veneer and cavity walls at 24 inches on center horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.
- B. Install cavity vents in veneer and cavity walls at 32 inches on center horizontally below shelf angles and lintels and near top of walls.

3.07 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.08 REINFORCEMENT AND ANCHORAGE - GENERAL

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.

3.09 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

- A. Install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

3.10 MASONRY FLASHINGS

- A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
- B. Extend metal flashings to within 1/4 inch of exterior face of masonry.

3.11 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control or expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

3.12 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames and other items to be built into the work and furnished under other sections.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

3.13 TOLERANCES

- A. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.
- B. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.
- C. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.
- D. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.
- E. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.
- F. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.14 CLEANING

- A. Remove excess mortar and mortar droppings.
- B. Clean soiled surfaces with cleaning solution.

3.15 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

SECTION 051200
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Structural steel framing members, support members.
- B. Base plates, expansion joint plates.
- C. Grouting under base plates.

1.02 RELATED REQUIREMENTS

- A. Section 05 3100 - Steel Decking: Support framing for small openings in deck.

1.03 REFERENCE STANDARDS

- A. AISC (MAN) - Steel Construction Manual; American Institute of Steel Construction, Inc.; 2023.
- B. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges; American Institute of Steel Construction, Inc.; 2022.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2012.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2012.
- F. ASTM A514/A514M - Standard Specification for High-Yield Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding; 2005 (Reapproved 2009).
- G. ASTM A992/A992M - Standard Specification for Structural Steel Shapes; 2011.
- H. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2013.
- I. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2010.
- J. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel; International Accreditation Service, Inc.; 2011.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Submit drawings showing complete details and schedules for fabrication and assembly of structural steel members. Drawings shall include the following minimum information:
 - 1. Details of cuts, connections, camber, holes, and other pertinent data.
 - 2. Indication of welds by standard AWS symbols, and show size, length, and type of each weld.
 - 3. Indication of type, size, and length of bolts, distinguishing between shop and field bolts. Identify the type of high-strength bolted connection (slip-critical, direct-tension, or bearing connections). Indicate locations of pretensioned bolts.
 - 4. Connection material specification and sizes.
 - 5. Joints or groups of joints in which a specific assembly order, welding sequence, welding technique, or other special precautions are required.
 - 6. Holes, flange cuts, slots, and openings shall be made as required by the structural drawings, all of which shall be properly located by means of templates.
 - 7. Setting drawings, templates, and directions for installation of anchor rods and other anchorages to be installed by others.
 - 8. Non-Destructive Testing (NDT) to be performed by the Fabricator, if any.
 - 9. A letter sealed by the Fabricator's Professional Engineer responsible for the design of any of the connections shown on the shop drawings attesting that the engineer has reviewed the shop drawings and that the connections detailed and shown on the shop drawings conform to the engineer's design.
- C. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

- D. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.
- E. Erection-Bracing Drawings: Submit, for record purposes only, complete erection-bracing drawings.

1.05 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC "Steel Construction Manual."
- B. Fabricator: The structural steel fabricator shall have not less than 5 years of experience in the successful fabrication of structural steel similar to this project.
- C. Erector: Company specializing in performing the work of this section with minimum 5 years of documented experience.
- D. Design connections not detailed on the drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- E. The Professional Engineer employed by the Fabricator for connection design shall be experienced in the specific area of structural steel connection design with demonstrated experience of not less than three projects of similar scope and complexity.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Steel Angles and Plates: ASTM A36/A36M.
- B. Steel W Shapes and Tees: ASTM A992/A992M.
- C. Rolled Steel Structural Shapes: ASTM A992/A992M.
- C. Square and Rectangular HSS: ASTM A500, Grade C (Fy=50 ksi)
- D. Steel Plate: ASTM A514/A514M.
- E. Structural Bolts and Nuts: ASTM F 3125 Grade A325 Type 1 or ASTM F 3125 Grade A490 Type 1
- F. Headed Studs used as Anchors for Structural Steel Plates and Members connecting to Concrete: AWS Type A studs manufactured in conformance with ASTM A 29 with a minimum tensile strength of 61,000 psi of sizes as specified on the drawings.
- G. Headed Studs used as Composite Member Shear Connectors: AWS type B studs manufactured in conformance with ASTM A 29 with a minimum tensile strength of 65,000 psi of sizes as specified on the drawings.
- H. All anchor rods shall conform to ASTM F 1554. unless noted otherwise on the drawings and shall be of the yield strength Grade 36. Substitution for Grade 36 anchor rods with Grade 55 anchor rods shall only be permitted provided the Grade 55 anchor rods comply with Supplementary requirements S1 of ASTM F 1554.
- I. Welding Materials: AWS D1.1; type required for materials being welded.
- J. Grout: Non-shrink, non-metallic aggregate type, complying with ASTM C1107/C1107M and capable of developing a minimum compressive strength of 7,000 psi (48 MPa) at 28 days.
- K. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

- A. Shop fabricate to greatest extent possible.
- B. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
- C. Fabricate connections for bolt, nut, and washer connectors.
- D. Camber of structural steel members is indicated on the drawings. Camber shall be measured in the Fabricator's shop in the unstressed condition, prior to erection. The Fabricator shall provide camber measurements of all beams and a report to the Testing Laboratory confirming this has been done. Where possible, camber of beams shall be applied by a cold bend process.
- E. Anchor Rods: Furnish anchor rods and other connectors required for securing structural steel to foundations and other in-place work. Furnish 1/8" minimum steel templates for presetting bolts and other anchors to accurate locations.

2.03 CONNECTIONS

- A. The Fabricator's detailer shall complete connection detailing using predesigned connections taken directly from the AISC "Steel Construction Manual".

2.04 FINISH

- A. Shop prime structural steel members. Do not prime surfaces that will be fireproofed, field welded, in contact with concrete, or high strength bolted.
- B. Coordinate all shop painting of structural steel with Architect's painting requirements as specified on the architectural drawings and in the specifications. The Fabricator shall be responsible for determining all painting requirements (which surfaces are to be painted or left unpainted) on the project prior to fabrication.
- C. All structural steel items and their connections permanently exposed to exterior conditions or that are within areas of unconditioned airspace, whether specified on the drawings or not, shall be hot-dip galvanized after fabrication unless indicated on the drawings or in Specification to receive a primer and/or finish coat.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.02 ERECTION

- A. Erect structural steel in compliance with AISC "Code of Standard Practice for Steel Buildings and Bridges".
- B. Allow for erection loads, and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. The Erector shall design and provide all required temporary shoring and bracing to hold structural framing securely in position and to safely withstand all loads as specified in the Code of Standard Practice and ASCE 37 unless larger loads are required by the local building code or specified herein. Provide all bracing, any additional structural members, and increase member sizes and/or connections shown on the drawings as required to accommodate the erection loads, methods, sequence of erection, and equipment until the lateral-load resisting or stability-providing system is completely installed. Clearly show all temporary supports and modifications to designed members on the Shop Drawings and the Erection-bracing Drawings. A qualified licensed professional engineer, hired by the Erector, shall design the temporary shoring and bracing and shall seal the erection-bracing drawings.
- D. Initial Survey: Check elevations of concrete and masonry bearing surfaces, anchor bolt locations, embedded connection plates, and all dimensions of existing structures to which new connections are to be made prior to erection and submit any discrepancies to the Engineer prior to the start of erection. Corrections or compensating adjustments to the structural steel shall be made and approved prior to the start of erection.

3.03 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4523.

END OF SECTION

SECTION 05 21 00
STEEL JOIST FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Open web steel joists, with bridging, attached seats and anchors.
- B. Loose bearing members, such as plates or angles, and anchor bolts for site placement.
- C. Supplementary framing for roof openings greater than 18 inches (450 mm).

1.02 RELATED REQUIREMENTS

- A. Section 05 1200 - Structural Steel Framing: Grouting base plates and bearing plates. Superstructure framing.
- B. Section 05 3100 - Steel Decking: Bearing plates and angles.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2012.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- C. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2012.
- D. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2010.
- E. SJI (SPEC) - Catalog of Standard Specifications and Load Tables for Steel Joists and Joist Girders; Steel Joist Institute; 2011.
- F. SSPC-Paint 25 - Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II; Society for Protective Coatings; 1997 (Ed. 2004).
- G. SSPC-SP 2 - Hand Tool Cleaning; Society for Protective Coatings; 1982 (Ed. 2004).

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate standard designations, joist coding, configurations, sizes, spacings, cambers, locations of joists, joist leg extensions, bridging, connections, and attachments.
- C. Design Calculations: Submit design calculations for all joists showing complete geometry and member sizes, including web and chord member splices to verify compliance with these specifications, contract drawings, and SJI specifications. Calculations shall be signed and sealed by a licensed engineer in the state where the project is located.
- D. Welders' Certificates: Submit manufacturer's certificates, certifying welders employed on the Work, verifying AWS qualification within the previous 12 months.
- E. Manufacturer's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Transport, handle, store, and protect products to SJI requirements.

1.06 QUALITY ASSURANCE

- A. The Contractor is responsible for quality control, including workmanship and materials furnished by his subcontractors and suppliers.
- B. Qualifications:

The steel joist manufacturer shall be a firm experienced in manufacturing joists similar to those indicated for this Project and with a record of successful in-service performance for a minimum of 2 years.

The steel joist manufacturer must show evidence of compliance with the submittal, testing, and inspection requirements of the Steel Joist Institute (SJI) Standard Specifications for verification of design and manufacturing.

- C. Design and Manufacturing: Provide joists designed and manufactured in compliance with the following, and as herein specified.
Steel Joist Institute (SJI) Standard Specifications, Load Tables and Weight Tables for K and LH/DLH Series Steel Joists and Joist Girders, latest edition.
Design top and bottom chords for additional bending stresses resulting from a vertical concentrated load of 100 pounds (service) located anywhere between panel points. This load is used only for a bending check of the chord members.
Recommended Code of Standard Practice for Steel Joists and Joist Girders, latest edition.
SJI Technical Digest #8 "Welding of Open Web Steel Joists"
Comply with all OSHA requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Steel Joists:
1. Nucor-Vulcraft Group: www.vulcraft.com.
 2. New Millennium
 3. Canam
 4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 MATERIALS

- A. Open Web Joists: SJI Type LH Joists:
1. Minimum End Bearing on Steel Supports: As shown on the drawings.
 2. Minimum End Bearing on Concrete or Masonry Supports: As shown on drawings.
 3. Finish: Shop primed.
- B. Anchor Bolts, Nuts and Washers: ASTM A 307, hot-dip galvanized per ASTM A 153/A 153M, Class C.
- C. Structural Steel For Supplementary Framing and Joist Leg Extensions: ASTM A36/A36M.
- D. Welding Materials: AWS D1.1; type required for materials being welded.
- E. Shop and Touch-Up Primer: SSPC-Paint 25, zinc oxide, complying with VOC limitations of authorities having jurisdiction.

2.03 FINISH

- A. Shop prime joists as specified.
- B. Prepare surfaces to be finished in accordance with SSPC-SP 2.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions prior to beginning work.

3.02 ERECTION

- A. Erect joists with correct bearing on supports.
- B. Allow for erection loads. Provide sufficient temporary bracing to maintain framing safe, plumb, and in true alignment.
- C. Coordinate the placement of anchors for securing loose bearing members furnished as part of the work of this section.
- D. After joist alignment and installation of framing, field weld joist seats to steel bearing surfaces.
- E. Install supplementary framing for floor and roof openings greater than 18 inches (450 mm).

- F. Do not permit erection of decking until joists are braced bridged, and secured or until completion of erection and installation of permanent bridging and bracing.
- G. Do not field cut or alter structural members without approval of joist manufacturer.

3.03 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch (6 mm).
- B. Maximum Offset From True Alignment: 1/4 inch (6 mm).

3.04 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000.

END OF SECTION

SECTION 053100
STEEL DECKING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roof deck.
- C. Composite floor deck.
- C. Supplementary framing for openings up to and including 18 inches (450 mm).
- D. Bearing plates and angles.

1.02 RELATED REQUIREMENTS

- A. Section 05 1200 - Structural Steel Framing: Support framing for openings larger than 18 inches (450 mm) and shear stud connectors.
- B. Section 05 2100 - Steel Joist Framing: Support framing for openings larger than 18 inches (450 mm) and shear stud connectors.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2012.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- C. AWS D1.1/D1.1M - Structural Welding Code - Steel; American Welding Society; 2010.
- D. AWS D1.3 - Structural Welding Code - Sheet Steel; American Welding Society; 2008.
- E. SDI (DM) - Publication No.31, Design Manual for Composite Decks, Form Decks, Roof Decks; Steel Deck Institute; 2007.

1.04 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittals procedures.
- B. Shop Drawings: Indicate deck plan, support locations, projections, openings, reinforcement, pertinent details, and accessories.
- C. Product Data: Provide deck profile characteristics, dimensions, structural properties, and finishes.
- D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.05 QUALITY ASSURANCE

- A. Design deck layout, spans, fastening, and joints under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Steel Deck:
 - 1. Cordeck, Inc: www.cordeck.com.
 - 2. Nucor-Vulcraft Group: www.vulcraft.com.
 - 3. New Millenium
 - 4. Canam

2.02 STEEL DECK

- A. Non-composite Form Deck Non-composite type, fluted steel sheet:
 - 1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 50 zinc coating.
 - 2. Metal Thickness: See Plan
 - 3. Nominal Height: 1 inch (1.0C deck)

4. Formed Sheet Width: 32 inch (minimum)
 5. Side Joints: See plan.
 6. End Joints: See plan.
- B. Roof Deck: Non-composite type, fluted steel sheet:
1. Galvanized Steel Sheet: ASTM A653/A653M, Structural Steel (SS) Grade 50, with G90/Z275 galvanized coating.
 2. Minimum Metal Thickness, Excluding Finish: 16 gage or 20 gage per plan.
 3. Nominal Height: 1-1/2 inch (38 mm).
 4. Profile: Fluted; SDI NR.
 5. Formed Sheet Width: 36 inch (600 mm).
 6. Side Joints: Interlocking Side-lap.
 7. End Joints: Lapped, welded.

2.03 ACCESSORY MATERIALS

- A. Bearing Plates and Angles: ASTM A36/A36M steel, unfinished.
- B. Welding Materials: AWS D1.1.
- C. Fasteners: Galvanized hardened steel, self tapping.
- D. Acoustical Insulation: Glass fiber type, minimum 1.1 lb/cu ft (18 kg/cu m) density; profiled to suit deck.

2.04 FABRICATED DECK ACCESSORIES

- A. Sheet Metal Deck Accessories: Metal closure strips, wet concrete stops, and cover plates, 22 gage (0.8 mm) thick sheet steel; of profile and size as indicated; finished same as deck.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions prior to beginning work.

3.02 INSTALLATION

- A. On steel supports provide minimum 1-1/2 inch (38 mm) bearing.
- B. Fasten deck to steel support members at ends and intermediate supports at 12 inches (300 mm) on center maximum, parallel with the deck flute and at each transverse flute using methods specified.
 1. Welding: Use fusion welds through weld washers.
- C. Clinch lock seam side laps.
- D. At welded male/female side laps weld at 18 inches (450 mm) on center maximum.
- E. Weld deck in accordance with AWS D1.3.
- F. Immediately after welding deck and other metal components in position, coat welds, burned areas, and damaged surface coating, with touch-up primer.
- G. Steel Deck Spans: The deck properties shown on the drawings are selected so that the spans do not exceed the maximum clear spans with unshored construction as required by SDI criteria unless indicated otherwise on the drawings. The deck manufacturer shall be responsible for supplying a deck that meets that criterion. Where possible, all steel deck shall extend over three or more spans. Simple span deck will not be permitted unless it is shored at midspan or approved by EOR.

END OF SECTION

**SECTION 055000
METAL FABRICATIONS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop fabricated steel and aluminum items.
- B. Prefabricated ladders.
- C. Bollards
- D. Downspout boots.
- E. Slotted channel framing.

1.02 RELATED REQUIREMENTS

- A. Section 042000 - Unit Masonry: Placement of metal fabrications in masonry.
- B. Section 055100 - Metal Stairs.
- C. Section 055213 - Pipe and Tube Railings.

1.03 REFERENCE STANDARDS

- A. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.
- B. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).
- C. ASTM A48/A48M - Standard Specification for Gray Iron Castings; 2022.
- D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- F. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
- G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- I. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- J. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- K. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2012.
- L. ASTM B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes (Metric); 2012.
- M. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2012.
- N. ASTM B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold-Finished Bar, Rod, and Wire (Metric); 2012.
- O. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- P. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- Q. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).

- R. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- S. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- T. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.
- U. SSPC-SP 2 - Hand Tool Cleaning; 2024.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 1. Design data: Submit drawings and supporting calculations, signed and sealed by a qualified professional structural engineer.
 - a. Include the following, as applicable:
 - 1) Design criteria.
 - 2) Engineering analysis depicting stresses and deflections.
 - 3) Member sizes and gages.
 - 4) Details of connections.
 - 5) Support reactions.
 - 6) Bracing requirements.
- C. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.
- D. Designer's Qualification Statement.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- E. Slotted Channel Framing: ASTM A653/A653M, Grade 33.
- F. Slotted Channel Fittings: ASTM A1011/A1011M.
- G. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
- H. Bolts, Nuts, and Washers: ASTM A307, Grade A, plain.
- I. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- J. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
- K. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 MATERIALS - ALUMINUM

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- B. Sheet Aluminum: ASTM B209 (ASTM B209M), 5052 alloy, H32 or H22 temper.
- C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210 (ASTM B210M), 6063 alloy , T6 temper.
- D. Aluminum-Alloy Bars: ASTM B211 (ASTM B211M), 6061 alloy , T6 temper.
- E. Bolts, Nuts, and Washers: Stainless steel.
- F. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.03 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FABRICATED ITEMS

- A. Bollards: Steel pipe, concrete filled, crowned cap, as detailed; prime paint finish.
- B. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing: For support of metal decking; prime paint finish.
- C. Lintels: As detailed; prime paint finish.

2.05 PREFABRICATED LADDERS

- A. Prefabricated Ladder: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
 - 1. Components: Manufacturer's standard rails, rungs, treads, handrails, returns, platforms and safety devices complying with the requirements of the MATERIALS article of this section.
 - 2. Materials: Aluminum; ASTM B221 (ASTM B221M), 6063 alloy, T52 temper.
 - 3. Finish: Manufacturer's standard clear anodized coating, comply with AAMA 611, Class 1.
 - 4. Products: Basis of Design- Okeeffe's Inc.; Model 503A.
 - a. Industrial Ladder & Scaffolding, Inc.: www.anyladder.com/sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- B. Prefabricated Ship Ladder: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.

2.06 DOWNSPOUT BOOTS

- A. Downspout Boots: Smooth interior without boxed corners or choke points; include integral lug slots, integral cleanout, cleanout cover, and tamper proof fasteners.
 - 1. Configuration: Angular.
 - 2. Material: Cast iron; ASTM A48/A48M; casting thickness 3/8 inch (9.5 mm), minimum.
 - 3. Finish: Manufacturer's standard factory applied powder coat finish.
 - 4. Color: To be selected by Architect from manufacturer's standard range.
 - 5. Accessories: Manufacturer's standard stainless steel fasteners, stainless steel building wall anchors, integral neoprene gaskets, and rubber coupling.
 - 6. Manufacturers:
 - a. Downspoutboots.com, a division of J. R. Hoe & Sons:
www.downspoutboots.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.07 FINISHES - STEEL

- A. Prime paint steel items.
 - 1. Exceptions: Galvanize items to be embedded in concrete and items to be embedded in masonry.
 - 2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.
- B. Prepare surfaces to be primed in accordance with SSPC-SP2.
- C. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- D. Prime Painting: One coat.

2.08 FINISHES - ALUMINUM

- A. Exterior Aluminum Surfaces: Class I natural anodized.
- B. Interior Aluminum Surfaces: Class I natural anodized.
- C. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

2.09 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete or embedded in masonry.

3.03 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

**SECTION 055213
PIPE AND TUBE RAILINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall mounted handrails.
- B. Stair railings and guardrails.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Placement of anchors in concrete.
- B. Section 042000 - Unit Masonry: Placement of anchors in masonry.
- C. Section 099000 - Painting and Coating.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- C. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- D. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2021.
- E. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings; 2024.
- F. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
- C. Samples: Submit two, 6 inch long samples of handrail. Submit two samples of elbow, wall bracket, and end stop.

1.05 QUALITY ASSURANCE

- A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.
- B. Welder Qualifications: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Handrails, Railings, Guardrails:
 - 1. Alumi-Guard: www.alumi-guard.com/sle.
 - 2. C.R. Laurence Company, Inc: www.crl-arch.com/sle.
 - 3. Kee Safety, Inc: www.keesafety.com.
 - 4. KaneSterling: www.sterlingdula.com.
 - 5. The Wagner Companies: www.wagnercompanies.com.
 - 6. Substitutions: See Section 016000 - Product Requirements.

2.02 RAILINGS - GENERAL REQUIREMENTS

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of ASTM E985 and applicable local code.

- B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935
- C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935
- D. Allow for expansion and contraction of members and building movement without damage to connections or members.
- E. Dimensions: See drawings for configurations and heights.
- F. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
- G. Provide slip-on non-weld mechanical fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.03 STEEL RAILING SYSTEM

- A. Steel Tube: ASTM A500/A500M Grade B cold-formed structural tubing.
- B. Steel Pipe: ASTM A53/A53M Grade B Schedule 80, black finish.
- C. Non-Weld Mechanical Fittings: Slip-on, galvanized malleable iron castings, for Schedule 40 pipe, with flush setscrews for tightening by standard hex wrench, no bolts or screw fasteners.
- D. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
- E. Exposed Fasteners: No exposed bolts or screws.
- F. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.04 FABRICATION

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.
- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
- D. Welded Joints:
 1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
 2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
 3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Install railings in compliance with ADA Standards for accessible design at applicable locations.
- D. Anchor railings securely to structure.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

**SECTION 061000
ROUGH CARPENTRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Rough opening framing for doors, windows, and roof openings.
- B. Sheathing.
- C. Roofing nailers.
- D. Preservative treated wood materials.
- E. Miscellaneous framing and sheathing.
- F. Communications and electrical room mounting boards.
- G. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

- A. Section 07276-Fluid-Applied Membrane Air Barriers: Membrane barrier over sheathing.

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
- C. AWPA U1 - Use Category System: User Specification for Treated Wood; 2024.
- D. PS 20 - American Softwood Lumber Standard; 2025.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide technical data on insulated sheathing, wood preservative materials, and application instructions.
- C. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.
- D. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
 - 2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.

- B. Lumber fabricated from old growth timber is not permitted.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: S-dry or MC19.
- C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS

- A. Wall Sheathing: Glass mat faced gypsum, ASTM C1177/C1177M, 5/8 inch Type X fire resistant.
 - 1. Edges: Square.
 - 2. Manufacturers:
 - a. CertainTeed Corporation; GlasRoc Brand: www.certainteed.com/#sle.
 - b. Georgia-Pacific Gypsum; DensGlass Sheathing: www.gpgypsum.com/#sle.
 - c. Substitutions: See Section 016000 - Product Requirements.

2.04 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
- B. Water-Resistive Barrier: As specified in Section 072500.

2.05 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 - 1. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.
- B. Preservative Treatment:
 - 1. Manufacturers:
 - a. Lonza Group: www.wolmanizedwood.com/#sle.
 - b. Koppers Performance Chemicals, Inc: www.koppersperformancechemicals.com/#sle.
 - c. Viance, LLC: www.treatedwood.com.
 - d. Osmose, Inc: www.osmose.com.
 - e. Substitutions: See Section 016000 - Product Requirements.
 - 2. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative.
 - a. Kiln dry lumber after treatment to maximum moisture content of 19 percent.
 - b. Treat lumber exposed to weather.
 - c. Treat lumber in contact with roofing, flashing, or waterproofing.

PART 3 EXECUTION

3.01 PREPARATION

- A. Where wood framing bears on cementitious foundations, install full width sill flashing continuous over top of foundation, lap ends of flashing minimum of 4 inches and seal.
- B. Coordinate installation of rough carpentry members specified in other sections.

3.02 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.

- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.
- C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

3.04 ROOF-RELATED CARPENTRY

- A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.
- B. Provide wood curb at all roof openings except where prefabricated curbs are specified and where specifically indicated otherwise. Form corners by alternating lapping side members.

3.05 INSTALLATION OF CONSTRUCTION PANELS

- A. Wall Sheathing: Secure with long dimension perpendicular to wall studs, with ends over firm bearing and staggered, using nails, screws, or staples.
- B. Communications and Electrical Room Mounting Boards: Secure with screws to studs with edges over firm bearing; space fasteners at maximum 24 inches on center on all edges and into studs in field of board.
 - 1. At fire-rated walls, install board over wall board indicated as part of the fire-rated assembly.
 - 2. Where boards are indicated as full floor-to-ceiling height, install with long edge of board parallel to studs.
 - 3. Install adjacent boards without gaps.

3.06 CLEANING

- A. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
- B. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

**SECTION 062000
FINISH CARPENTRY**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Finish carpentry items.
- B. Wood casings and moldings.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- B. Section 064100 - Architectural Wood Casework: Shop fabricated custom cabinet work.

1.03 REFERENCE STANDARDS

- A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- B. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2020.
- C. NHLA G-101 - Rules for the Measurement and Inspection of Hardwood and Cypress; 2023.
- D. PS 1 - Structural Plywood; 2023.
- E. PS 20 - American Softwood Lumber Standard; 2025.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Provide manufacturer's product data, storage and handling instructions for factory-fabricated units.
 - 2. Provide instructions for attachment hardware and finish hardware.
- C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
- D. Samples: Submit two samples of finish wood wall paneling, 12 x 12 inch in size illustrating wood grain and specified finish.
- E. Samples: Submit two samples of wood trim 12 inch long.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year warranty for resilient stage floor to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated units to project site in original packages, containers or bundles bearing brand name and identification.
- B. Store finish carpentry items under cover, elevated above grade, and in a dry, well-ventilated area not exposed to heat or sunlight.
- C. Protect work from moisture damage.
- D. Handle materials and products to prevent damage to edges, ends, or surfaces.
- E. Place wood flooring materials in stage area at least 7 days in advance of start of installation. Open sealed packages of wood flooring to permit natural adjustment of moisture content.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMA/WI (AWS) or AWMA/WI (NAAWS), unless noted otherwise.
- B. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.
- C. Interior Woodwork Items:
 - 1. Moldings, Bases, Casings, and Miscellaneous Trim; prepare for transparent finish.
 - 2. Wood Wall Paneling (WD-1).
 - a. Size: 1 x 8 nominal.
 - b. Species and Finish: Pine, primed and painted.

2.02 LUMBER MATERIALS

- A. Hardwood Lumber: Douglas Fir species, plain sawn, maximum moisture content of 6 percent; with flat grain, of quality suitable for transparent finish.
 - 1. Grading: In accordance with NHLA G-101 Grading Rules; www.nhla.org.

2.03 SHEET MATERIALS

- A. Softwood Plywood, Not Exposed to View: Any face species, medium density fiberboard core; PS 1 Grade A-B, glue type as recommended for application.
- B. Softwood Plywood, Exposed to View: Face species as indicated, plain sawn, medium density fiberboard core; PS 1 Grade A-B, glue type as recommended for application.
 - 1. Grading: Certified by the American Plywood Association.
- C. Hardwood Plywood: Face species Maple, plain sawn, book matched, veneer core; HPVA HP-1, Front Face Grade AA, Back Face Grade 1, glue type as recommended for application.

2.04 FASTENINGS

- A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.
- B. Adhesive for factory-fabricated units: Manufacturer's recommended adhesive for application.

2.05 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Lumber for Shimming and Blocking: Softwood lumber of pine species.
- C. Primer: Alkyd primer sealer.
- D. Wood Filler: Solvent base, tinted to match surface finish color.

2.06 SITE FINISHING MATERIALS

- A. Basis of Design: Masters Armor by Old Masters.

2.07 FABRICATION

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. Fit exposed sheet material edges with 3/8 inch matching hardwood edging. Use one piece for full length only.
- C. Shop prepare and identify components for book match grain matching during site erection.
- D. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

2.08 FIELD FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. Apply wood filler in exposed nail and screw indentations.

- C. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.
- D. Prime paint surfaces in contact with cementitious materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

- A. Install work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure materials and components in place, plumb and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

3.03 PREPARATION FOR SITE FINISHING

- A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.

3.04 TOLERANCES

- A. Maximum Variation from True Position: 1/16 inch.
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

END OF SECTION

**SECTION 064100
ARCHITECTURAL WOOD CASEWORK**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Cabinet hardware.

1.02 REFERENCE STANDARDS

- A. BHMA A156.9 - Cabinet Hardware; 2020.
- B. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- C. BHMA A156.9 - American National Standard for Cabinet Hardware; Builders Hardware Manufacturers Association; 2010 (ANSI/BHMA A156.9).
- D. NEMA LD 3 - High-Pressure Decorative Laminates; National Electrical Manufacturers Association; 2005.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
- C. Product Data: Provide data for hardware accessories.

1.04 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.06 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 CABINETS

- A. Cabinets:
 - 1. Finish - Exposed Exterior Surfaces: Decorative laminate.
 - 2. Finish - Concealed Surfaces: Manufacturer's option.
 - 3. Door and Drawer Front Edge Profiles: 3 mm edge band.
 - 4. Adjustable Shelf Loading: 50 lbs. per sq. ft.
 - 5. Cabinet Style: Flush overlay.
 - 6. Drawer Side Construction: Doweled.
 - 7. Drawer Construction Technique: Dowel joints.

2.02 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.

2.03 LAMINATE MATERIALS

- A. Manufacturers:
 - 1. Formica Corporation: www.formica.com/#sle.
 - 2. Wilsonart: www.wilsonart.com.
 - 3. Substitutions: See Section 016000 - Product Requirements.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.

2.04 COUNTERTOPS

- A. Countertops are specified in Section 123600.

2.05 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Plastic Edge Banding: Extruded PVC, flat shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
 - 1. Color: As selected by Architect from manufacturer's standard range.
- C. Acrylic Resin Panels: 3form Chroma. See Finish Schedule for colors
- D. Fasteners: Size and type to suit application.
- E. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and chrome-plated finish in exposed locations.
- F. Concealed Joint Fasteners: Threaded steel.
- G. Grommets: Standard plastic grommets for cut-outs, in color to match adjacent surface.

2.06 HARDWARE

- A. Hardware: BHMA A156.9, types as recommended by fabricator for quality grade specified.
- B. Adjustable Shelf Supports: Standard back-mounted system using surface mounted metal shelf standards and coordinated cantilevered shelf brackets, satin chrome, painted, or painted finish, for nominal 1 inch spacing adjustments.
- C. Countertop Supports:
 - 1. Material: Aluminum
 - 2. Finish/Color: Black powdercoat.
 - 3. Manufacturers:
 - a. Rakks/Rangine Corporation; Sill Supports: www.rakks.com/#sle
- D. Drawer and Door Pulls: "U" shaped wire pull, steel with chrome finish, 4 inch centers.
- E. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.
- F. Catches: Magnetic.
- G. Drawer Slides:
 - 1. Type: Extension types as scheduled.
 - 2. Static Load Capacity: Commercial grade.
 - 3. Mounting: Side mounted.
 - 4. Stops: Integral type.
 - 5. Manufacturers
 - a. Accuride International, Inc: www accuride.com.
 - b. Grass America Inc: www.grassusa.com.
 - c. Hettich America, LP: www.hettichamerica.com.
 - d. Knappe & Vogt Manufacturing Company: www.knapeandvogt.com.
 - e. Substitutions: See Section 016000 - Product Requirements.
- H. Hinges: European style concealed self-closing type, steel with polished finish.
 - 1. Manufacturers:
 - a. Grass America Inc: www.grassusa.com.
 - b. Hardware Resources: www.hardwareresources.com.
 - c. Hettich America, LP; Sensys: www.hettichamerica.com/#sle.
 - d. Julius Blum, Inc: www.blum.com.
 - e. Substitutions: See Section 016000 - Product Requirements.

2.07 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.

- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners.
 - 1. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- E. Mechanically fasten back splash to countertops as recommended by laminate manufacturer at 16 inches on center.
- F. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

- A. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- B. Use fixture attachments in concealed locations for wall mounted components.
- C. Use concealed joint fasteners to align and secure adjoining cabinet units.
- D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.

3.03 ADJUSTING

- A. Adjust installed work.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

**SECTION 068316
FIBERGLASS REINFORCED PANELING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fiberglass reinforced plastic panels.
- B. Trim.

1.02 REFERENCE STANDARDS

- A. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2022.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fiberglass Reinforced Plastic Panels: Basis of Design: Marlite
 - 1. Crane Composites, Inc: www.cranecomposites.com/#sle.
 - 2. Nudo Products, Inc: www.nudo.com/#sle.
 - 3. Panolam Industries International, Inc: www.panolam.com/#sle.
 - 4. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PANEL SYSTEMS

- A. Wall Panels:
 - 1. Panel Size: 4 by 10 feet.
 - 2. Panel Thickness: 0.09 inch.
 - 3. Surface Design: Flat.
 - 4. Color: Red.
 - 5. Attachment Method: Adhesive only, sealant joints, no trim.

2.03 MATERIALS

- A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.
 - 1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.
- B. Trim: Vinyl; color coordinating with panel.
- C. Sealant: Type recommended by panel manufacturer; white.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions and substrate flatness before starting work.
- B. Verify that substrate conditions are ready to receive the work of this section.

3.02 INSTALLATION - WALLS

- A. Install panels in accordance with manufacturer's instructions.
- B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.
- C. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.
- D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.
- E. Install panels with manufacturer's recommended gap for panel field and corner joints.
- F. Place trim on panel before fastening edges, as required.
- G. Fill channels in trim with sealant before attaching to panel.
- H. Install trim with adhesive and screws or nails, as required.
- I. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.
- J. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION

**SECTION 072100
THERMAL INSULATION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Board insulation at cavity wall construction, perimeter foundation wall, and underside of floor slabs.
- B. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Field-applied termiticide for concrete slabs and foundations.
- B. Section 042000 - Unit Masonry: Masonry walls enclosing insulation.
- C. Section 061000 - Rough Carpentry: Supporting construction for batt insulation.

1.03 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- B. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

1.05 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 APPLICATIONS

- A. Insulation Under Concrete Slabs: Extruded polystyrene (XPS) board.
- B. Insulation at Perimeter of Foundation: Extruded polystyrene (XPS) board.
- C. Insulation Inside Masonry Cavity Walls: Extruded polystyrene (XPS) carbon black board.
- D. Insulation in Metal Framed Walls: Batt insulation with integral vapor retarder.

2.03 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene Board Insulation: Extruded polystyrene board; ASTM C578; with either natural skin or cut cell surfaces, and the following characteristics:
 - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 3. R-value; 1 inch of material at 72 degrees F: 5, minimum.
 - 4. Complies with fire resistance requirements shown on the drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
 - 5. Board Edges: Square.
 - 6. Water Absorption, Maximum: 0.3 percent, by volume.
 - 7. Manufacturers:

- a. Dow Chemical Co: www.dow.com.
 - b. Owens Corning Corporation; FOAMULAR Extruded Polystyrene (XPS) Insulation: www.ocbuildingspec.com.
 - c. Substitutions: See Section 016000 - Product Requirements.
- B. Extruded Polystyrene (XPS) Cavity Wall Insulation Board: Complies with ASTM C578, and manufactured using carbon black technology.
- 1. Type and Compressive Resistance: Type IV, 25 psi (173 kPa), minimum.
 - 2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
 - 3. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
 - 4. Type and Thermal Resistance, R-value: Type IV, 5.0 (0.88), minimum, per 1 inch thickness at 75 degrees F mean temperature.

2.04 BATT INSULATION MATERIALS

- A. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
- 1. Flame Spread Index: 75 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 3. Formaldehyde Content: Zero.
 - 4. Manufacturers:
 - a. CertainTeed Corporation: www.certainteed.com/#sle.
 - b. Johns Manville: www.jm.com/#sle.
 - c. Owens Corning Corporation; EcoTouch PINK FIBERGLAS Insulation: www.ocbuildingspec.com/#sle.
 - 5. Substitutions: See Section 016000 - Product Requirements.

2.05 ACCESSORIES

- A. Tape joints of rigid insulation in accordance with roofing and insulation manufacturers' instructions.
- B. Nails or Staples: Steel wire; electroplated or galvanized; type and size to suit application.
- C. Wire Mesh: Galvanized steel, hexagonal wire mesh.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT FOUNDATION PERIMETER

- A. Install boards horizontally on foundation perimeter.
 - 1. Butt edges and ends tightly to adjacent boards and to protrusions.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.03 BOARD INSTALLATION AT CAVITY WALLS

- A. Install boards to fit snugly between wall ties.
- B. Install boards horizontally on walls.
- C. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

3.04 BOARD INSTALLATION UNDER CONCRETE SLABS

- A. Place insulation under slabs on grade after base for slab has been compacted.
- B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- C. Prevent insulation from being displaced or damaged while placing vapor retarder and placing slab.

3.05 BATT INSTALLATION

- A. Install insulation in accordance with manufacturer's instructions.
- B. Install in exterior wall and roof spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.06 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

**SECTION 072726
FLUID-APPLIED MEMBRANE AIR BARRIERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fluid-applied membrane air barriers.

1.02 RELATED REQUIREMENTS

- A. Section 042000 - Unit Masonry: Concrete masonry.
- B. Section 061000 - Rough Carpentry: Exterior sheathing.
- C. Section 079200 - Joint Sealants: Sealants applied to adjacent work.

1.03 REFERENCE STANDARDS

- A. ASTM C719 - Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle); 2022.
- B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- C. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.
- D. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).
- E. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- G. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
- H. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.
- I. ASTM E2357 - Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies; 2024.
- J. ASTM G154 - Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials; 2023.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on material characteristics, performance criteria, and limitations.
- C. Shop Drawings: Provide drawings of special joint conditions.
- D. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.
- E. Manufacturer's qualification statement.
- F. Installer's qualification statement.
- G. Warranty Documentation: Submit manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in original packaging with seals unbroken and properly labeled.
- B. Store materials in their original undamaged packaging within clean, dry, and protected location at a temperature less than 90 degrees F.

1.07 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by materials manufacturer before, during, and after installation.
 - 1. Do not apply air barrier products when air or substrate temperatures are above 100 degrees F or below 20 degrees F.
 - 2. Allow wet substrates to dry prior to applying air barrier products.

1.08 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Warranty: Include coverage to repair or replace air barrier coatings and accessory products that demonstrate deterioration or failure within a 10-year period after Date of Substantial Completion due to material failure under normal use; failure includes water or air penetration through air barrier assembly.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fluid-Applied Membrane Air Barrier:
 - 1. Carlisle: www.carlisleccw.com#sle.
 - 2. Dow Chemical Company: www.dow.com/#sle.
 - 3. Tremco: www.tremcosealants.com#sle.
 - 4. W.R. Meadows, Inc.: www.wrmeadows.com#sle.
 - 5. Substitutions: See Section 016000 - Product Requirements.

2.02 FLUID-APPLIED MEMBRANE AIR BARRIER ASSEMBLY

- A. Fluid-Applied Membrane Air Barrier: Single-component, vapor permeable, 100 percent silicone elastomeric air barrier.
 - 1. Dry Film Thickness (DFT): 30 mils, .03 inch, minimum.
 - 2. Air Permeance: 0.004 cfm/sq ft maximum leakage when tested at 1.57 psf pressure difference in accordance with ASTM E2178.
 - 3. Vapor Permeance: 10 perms, minimum, when tested in accordance with ASTM E96/E96M using Desiccant Method at 73.4 degrees F.
 - 4. Air Barrier Leakage: Not greater than 0.04 cfm/sq ft of surface area at pressure of 1.57 psf when tested in accordance with ASTM E2357.
 - 5. Ultraviolet (UV) Exposure: Rated for up to 5,000 hours of exposure in accordance with ASTM G154; not less than 12 months.
 - 6. Elongation: Greater than 1300 percent, when tested in accordance with ASTM D412.
 - 7. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - 8. Nail Sealability: Pass head of water test in accordance with ASTM D1970/D1970M.
 - 9. Sealants, Tapes, and Accessories: As recommended by coating manufacturer.
- B. Primer: Water-based silicone adhesion promoter.
- C. Preformed Transition Strips and Molded Corners: Semi-rigid silicone elastomer extrusion, tear resistant, with tapered edges; applied and adhered with sealant.
- D. Preformed Flashing and Transition Seals: Factory formed silicone extrusion profile for adhered application to overlay face of joint.
 - 1. Profile Width: 3-1/2 inches wide, minimum.
- E. Weatherproofing Silicone Sealant: ASTM C920, Type S, Grade NS, Class 50, Uses NT, M, G,

and A; not expected to withstand continuous water immersion or traffic.

1. Joint Movement Capability: Plus or minus 50 percent, minimum, when tested in accordance with ASTM C719.
 2. Staining: None to concrete, brick, granite, or limestone when tested in accordance with ASTM C1248.
- F. Liquid Flashing: One part, neutral-cure silicone sealant, trowelable liquid flashing.
1. Applied Thickness: 40 mils, nominal.

2.03 ACCESSORIES

- A. Thinners and Cleaners: As recommended by material manufacturer.
- B. Crack Fillers: Provide substrate manufacturer's recommended crack fillers or sealants compatible with air barrier assembly components and adjacent materials.
- C. Block Filler: Provide air barrier coating manufacturer's recommended latex block filler compatible with substrate and adjacent materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and conditions are ready to accept work of this section.
- B. Verify that surfaces are clean, dry, and free of frost, dust, dirt, grease, oil, curing compounds, form release agents, laitance, efflorescence, mildew, excess alkalinity, and other conditions affecting performance of this work.
- C. Verify that new concrete and mortar to receive coating application has cured in accordance with substrate and air barrier coating manufacturer's instructions.
- D. Proceed with work once conditions comply with air barrier coating manufacturer's recommendations.

3.02 PREPARATION

- A. Protect work of other trades against damage from application of air barrier coatings.
- B. Protect adjacent surfaces not designated to receive air barrier coatings; provide protection for pedestrians, vehicles, landscaping, and surrounding areas to prevent contact with coating materials.
- C. Clean substrates to remove contaminants and foreign material by pressure cleaning, wire brushing, grinding or other method recommended by air barrier coatings manufacturer.
- D. Prepare substrates in accordance with air barrier coating manufacturer's written instructions.
- E. Repair deteriorated or damaged substrates, repair masonry joints, and fill cracks, voids, honeycombs, and other defects using materials as recommended by air barrier coating manufacturer, and allow patching materials to fully cure.
1. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
 2. Fill cracks larger than 1/16 inch wide using applicable joint sealant, and fill cracks larger than 1 inch wide using joint sealant and compatible bond breaker where movement is expected.
- F. Primer: Apply primer to substrates where required based upon preinstallation testing and air barrier coating manufacturer's recommendations, using application methods and rate of application recommended by manufacturer; allow primer to fully dry prior to application of air barrier coating.
1. Apply block filler as primer on concrete masonry unit (CMU) substrates where required to fill pores and provide smooth application of air barrier coating.

3.03 APPLICATION

- A. Apply air barrier system materials in accordance with manufacturer's instructions.
- B. Transition Strips and Silicone Sealants: Install with approved sealants in accordance with

manufacturer's written instructions.

1. Form sealed joints to windows, wall framing systems, door and louver frames, roofing system perimeters, and at interface with other adjacent materials utilizing compatible components that form air barrier assembly.
 2. Ensure laps and bonds are adhered to substrates.
- C. Air Barrier Coating: Apply air barrier coating using application methods and rate of application recommended by manufacturer, using nap roller or airless sprayer, in accordance with requirements of authorities having jurisdiction (AHJ).
1. Provide wet application not less than 50 mils, 0.050 inch thick, or more as required by substrate conditions, with dry film thickness (DFT) not less than 30 mils, 0.030 inch thick.
 2. Apply additional coats as required to provide uniform, continuously cured, airtight and watertight film.

3.04 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Do not cover installed air barriers until required inspections have been completed.
- C. Owner may retain testing agency to perform the following tests:
 1. ASTM D4541 - Pull-off strength of air barrier membranes.
 2. AAMA 501.2 Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems.
 3. E779 Standard Test Method for Determining Air Leakage Rate by Fan Pressurization.
 4. ASTM E283: Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 5. ASTM E 1105 Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Wall by Uniform or Cyclic Static Air Pressure
- D. If testing indicates products or current installation does not meet requirements, Owner may have materials removed from substrates that are not in compliance, and have other necessary corrections made to ensure application meets designated requirements.

3.05 CLEANING

- A. During completion of this work, remove overspray and excess material, using materials and methods approved by manufacturer that will not damage adjacent materials.
- B. Clean and repair adjacent surfaces damaged by air barrier coating application.

3.06 PROTECTION

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.
- B. Allow air barrier coatings to fully cure before exposure to traffic or other construction operations.
- C. Prevent damage to coatings from construction operations or other causes.
- D. Replace damaged air barrier coatings prior to concealment behind subsequent construction.

END OF SECTION

**SECTION 074213
METAL WALL PANELS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manufactured metal panels for walls, with related flashings and accessory components.

1.02 RELATED REQUIREMENTS

- A. Section 072500 - Weather Barriers: Weather barrier under wall panels.
- B. Section 092116 - Gypsum Board Assemblies: Wall panel substrate.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
 - 1. Physical characteristics of components shown on shop drawings.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation instructions and recommendations.
- C. Shop Drawings: Indicate dimensions, layout, joints, construction details, methods of anchorage.
- D. Samples: Submit one samples of wall panel, 12 inch by 12 inch in size illustrating finish color, sheen, and texture.
- E. Installer's Qualification Statement.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in installing the products specified in this section with minimum three years of documented experience.

1.05 MOCK-UP

- A. Construct mock-up, 8 feet long by 4 feet wide; include panel and soffit system, glazing, attachments to building frame, associated vapor retarder and air seal materials, weep drainage system, sealants and seals, related insulation in mock-up.
- B. Locate where directed.
- C. Mock-up may remain as part of the Work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
- B. Store prefinished material off ground and protected from weather. Prevent twisting, bending, or abrasion, and provide ventilation to stored materials. Slope metal sheets to ensure drainage.
- C. Prevent contact with materials that may cause discoloration or staining of products.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective work within a five year period after the Date of Substantial Completion for degradation of panel finish, including color fading caused by exposure to weather.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Metal Wall Panels MP-1: PAC-CLAD; Precision Series Box Rib 1

2.02 MANUFACTURED METAL PANELS

- A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.
 - 1. Provide exterior panels and subgirt framing assembly.
 - 2. Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall.
 - 3. Maximum Allowable Deflection of Panel: 1/90 of span.
 - 4. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement within system; movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.
 - 5. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
 - 6. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
 - 7. Corners: Factory-fabricated in one continuous piece with minimum 18 inch returns.
- B. Exterior Panels: MP-1
 - 1. Profile: Horizontal.
 - 2. Material: Precoated steel sheet, 24 gage, .0239 inch minimum thickness.
 - 3. Panel Width: 12"
 - 4. Height: 1-3/4"
 - 5. Color: As selected by Architect from manufacturer's full /custom line to match existing.
- C. Subgirt Framing Assembly:
 - 1. 16 gage, 0.0598 inch thick formed non-precoated steel sheet.
- D. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.
- E. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles. Provide trim to cover back-up framing where occurs- coordinate with drawings.
- F. Anchors: Galvanized steel or Stainless steel.

2.03 MATERIALS

- A. Precoated Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, Structural Steel (SS) or Forming Steel (FS), with G90/Z275 coating; continuous coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

2.04 FINISHES

- A. Exposed Surface Finish: Panel manufacturer's standard polyvinylidene fluoride (PVDF) coating, top coat over epoxy primer.

2.05 ACCESSORIES

- A. Cladding Support Clips: Thermally-broken, galvanized steel clips for support of cladding z-girts, angles, channels and other framing.
 - 1. Galvanized Steel Sheet: ASTM A653/A653M, with G90/Z275 galvanized coating.
 - 2. Manufacturers:
 - a. Northern Facades; ISO Clip: www.northernfacades.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- B. Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant.
- C. Concealed Sealants: Non-curing butyl sealant or tape sealant.
- D. Fasteners: Manufacturer's standard type to suit application; with soft neoprene washers, steel, hot dip galvanized. Fastener cap same color as exterior panel.
 - 1. Metal-to-Metal Fasteners: Self-drilling, self-tapping screws.

- E. Touch-up Paint: As recommended by panel manufacturer.
- F. Bituminous Paint: Asphalt base.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that building framing members are ready to receive panels.
- B. Verify that weather barrier has been installed over substrate completely and correctly.

3.02 PREPARATION

- A. Install subgirts perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane. Space at intervals indicated.

3.03 INSTALLATION

- A. Install panels on walls in accordance with manufacturer's instructions.
- B. Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint. Allow to dry prior to installation.
- C. Fasten panels to structural supports; aligned, level, and plumb.
- D. Use concealed fasteners unless otherwise approved by Architect.
- E. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

3.04 TOLERANCES

- A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch.
- B. Maximum Variation from Plane or Location Indicated on Drawings: 1/4 inch.

3.05 CLEANING

- A. Remove site cuttings from finish surfaces.
- B. Remove protective material from wall panel surfaces.
- C. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

END OF SECTION

SECTION 075323
ETHYLENE-PROPYLENE-DIENE-MONOMER ROOFING (EPDM)

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. EPDM membrane roofing system and accessories.
- B. Cover board.
- C. Insulation.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Wood nailers associated with roofing and roof insulation.

1.03 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D1079 for definition of terms related to roofing work not otherwise defined in section.

1.04 REFERENCE STANDARDS

- A. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2022.
- B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019, with Editorial Revision (2023).
- C. ASTM C209 - Standard Test Methods for Cellulosic Fiber Insulating Board; 2020.
- D. ASTM C473 - Standard Test Methods for Physical Testing of Gypsum Panel Products; 2019.
- E. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.
- F. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
- G. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2023a.
- H. ASTM D1079 - Standard Terminology Relating to Roofing and Waterproofing; 2020.
- I. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics; 2016 (Reapproved 2023).
- J. ASTM D1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics; 2020.
- K. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- L. ASTM D4811/D4811M - Standard Specification for Nonvulcanized (Uncured) Rubber Sheet Used as Roof Flashing; 2016 (Reapproved 2023).
- M. FM 4470 - Examination Standard for Single-Ply, Polymer-Modified Bitumen Sheet, Built-Up Roof (BUR) and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction; 2022.
- N. FM DS 1-28 - Wind Design; 2015, with Editorial Revision (2024).
- O. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; 2016, with Editorial Revision (2022).
- P. NRCA (RM) - The NRCA Roofing Manual; 2024.
- Q. PS 1 - Structural Plywood; 2023.
- R. PS 20 - American Softwood Lumber Standard; 2025.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate with installation of associated counter flashings and roof drainage components installed under other sections.
 - 2. Coordinate installation with adjacent flashings and air barrier systems for compatibility and continuity.
- B. Preinstallation Meeting: Convene one week before starting work of this section.
 - 1. Agenda:
 - a. Sequence of construction.
 - b. Roofing materials approved for use.
 - c. Coordination with installation of adjacent and covering materials.
 - d. Construction details.
 - 2. Require attendance of parties directly influencing roofing work quality or affected by roofing work performance.

1.06 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Provide membrane manufacturer's printed data showing roofing system components comply with specified requirements and with membrane manufacturer's requirements and recommendations for system type specified; include data for each product used in conjunction with roofing membrane, including insulation and fasteners.
 - 2. Provide documentation showing roofing system is UL classified or FM approved where UL or FM requirements are specified; include data itemizing classified or approved system components.
- C. Shop Drawings: Indicate membrane manufacturer's standard details drawn to scale and customized for project for relevant conditions.
 - 1. Include flashings, base tie-ins, roof edges, terminations, expansion joints, penetrations, and drains.
 - 2. For tapered insulation, indicate project-specific layout, slopes, thicknesses, and dimensions.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- E. Manufacturer's Instructions: Indicate installation of components; where instructions allow installation options, clearly indicate which option to use.
- F. Installer's qualification statement.
- G. Executed warranty.
- H. Specimen Warranty: Submit before starting work.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of this section with minimum five years of documented experience installing specified system and having the following:
- B. Documents at Project Site: Maintain at project site one copy of manufacturer's installation instructions.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original containers, dry and undamaged, with seals and labels intact and legible.
- B. Store materials clear of ground and moisture with weather-protective covering.
- C. Keep combustible materials away from ignition sources.
- D. Ensure storage and staging of materials does not exceed static and dynamic loadbearing capacities of roof decking.

- E. Protect foam insulation from direct exposure to sunlight.

1.09 FIELD CONDITIONS

- A. Do not apply roofing membrane during unsuitable weather or when ambient conditions conflict with manufacturer's installation instructions.
- B. Schedule applications so no partially completed sections of roof are left exposed at end of workday.

1.10 WARRANTY

- A. See Section 017800 - Closeout Submittals for additional warranty requirements.
- B. Comply with warranty procedures required by manufacturer, including notifications, scheduling, and inspections.
- C. Manufacturer Warranty: Full system warranty; 20-year Red Shield limited warranty covering membrane, roof insulation, and membrane accessories.
 - 1. Liability Limit: No dollar limitation.
 - 2. Scope of Coverage: Repair leaks in roofing system caused by:
 - a. Ordinary wear and tear of elements.
 - b. Manufacturing defects in Elevate brand materials.
 - c. Defective workmanship used to install materials.
 - d. Damage due to winds up to 90 mph.
 - e. Hail up to 2 inches in diameter.
 - 3. Not Covered:
 - a. Damage to winds over specified speed.
 - b. Damage due to hurricanes or tornadoes.
 - c. Intentional damage.
 - d. Unintentional damage due to normal rooftop inspections, maintenance, or service.
- D. Metal Roof Edging System Warranty: Include edge metals in membrane manufacturer's full system warranty.
- E. Metal Roof Edging System Finish Warranty: Provide 20-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. Membrane Roofing System:
 - 1. Basis of Design: Elevate: www.holcimelevate.com/#sle.
 - 2. Carlisle Syntec Systems: www.carlisesyntec.com/#sle.
 - 3. Versico Roofing Systems: www.versico.com/#sle
 - 4. Johns Manville: www.jm.com/#sle.
- B. Insulation: Same manufacturer as roof membrane.
- C. Substitutions: See Section 016000 - Product Requirements.
- D. Source Limitations: Furnish products produced by single manufacturer.

2.02 EPDM MEMBRANE ROOFING SYSTEM

- A. Description: EPDM single-ply membrane.
 - 1. Membrane Attachment: Fully adhered.
 - 2. Provide assembly having Underwriters Laboratories, Inc. (UL) Class B fire hazard classification.
 - 3. Provide assembly complying with Factory Mutual Corporation (FM) Roof Assembly Classification, FM DS 1-28 and FM DS 1-29, and meeting minimum requirements of FM 1-90 wind uplift rating.
- B. Components, from Top of Roof Down:

1. Membrane: Thickness as specified below.
2. Cover Board: High-density polyisocyanurate; 1/2 inch thick; mechanically fastened.
3. Insulation:
 - a. Maximum Board Thickness: 3 inches; use as many layers as necessary; stagger joints in adjacent layers.
 - b. Tapered: Minimum slope as indicated on drawings; provide minimum R-value at thinnest point; place tapered layer on top or on bottom.
 - c. Total System R-value: 30, minimum.
 - d. Top Layer: Polyisocyanurate foam board, noncomposite; mechanically fastened. See Drawings
 - e. Intermediate Layer: Polyisocyanurate foam board, noncomposite; mechanically fastened.
 - f. Bottom Layer: Polyisocyanurate foam board, noncomposite; mechanically fastened.
 - g. Crickets: Tapered insulation of same type as specified for top layer; slope as indicated on drawings.

2.03 MEMBRANE MATERIALS

- A. Roofing and Flashing Membrane: Cured synthetic single-ply membrane composed of EPDM with the following properties:
 1. Membrane and Flashing Color: Black.
 2. Thickness: 60 mils, 0.06 inch
 3. Nominal Thickness Tolerance: Plus/minus 10 percent.
 4. Sheet Width: Provide widest available sheets to minimize field seaming.
 5. Products: Basis of Design: Elevate EPDM Membrane.
 - a.
- B. Flashing Membrane: Self-curing, nonreinforced membrane composed of nonvulcanized EPDM rubber, complying with ASTM D4811/D4811M, Type II, with the following properties:
 1. Thickness: 55 mils, 0.055 inch.
 2. Product: Elevate; RubberGard EPDM FormFlash.
- C. Self-Adhesive Flashing Membrane: Semi-cured 45-mil, 0.045-inch EPDM membrane laminated to 35-mil, 0.035-inch EPDM tape adhesive.
 1. Product: Elevate; QuickSeam Flashing.
- D. Premolded Pipe Flashings: EPDM, molded for quick adaptation to different sized pipes.
 1. Product: Elevate; EPDM Pipe Flashing.
- E. Self-Adhesive Lap Splice Tape: 35 mil EPDM based, formulated for compatibility with EPDM membrane and high-solids primer.
 1. Product: Elevate; QuickSeam Splice Tape.
- F. Splice Adhesive: Manufacturer's recommended synthetic polymer-based, formulated for compatibility with EPDM membrane and metal surfaces.
- G. Bonding Adhesive: Manufacturer's recommended bonding adhesive, formulated for compatibility with EPDM membrane and other substrate materials, including masonry, wood, and insulation facings.
- H. Adhesive Primer: Manufacturer's recommended primer formulated for compatibility with EPDM membrane and tape adhesive.
- I. Lap Sealant: Manufacturer's recommended lap sealant formulated for compatibility with primers and flashings.
- J. AP Sealant: Manufacturer's recommended single-component, polyurethane, nonsag, moisture-curing sealant.
- K. Seam Edge Treatment: Manufacturer's recommended EPDM rubber-based sealant, formulated for sealing exposed membrane edges at seams.
- L. Pourable Sealer: Manufacturer's recommended two-part polyurethane, two-color for reliable

mixing.

- M. Water Block Seal: Manufacturer's recommended butyl rubber sealant for use between two surfaces, not exposed.
- N. Metal Plates and Strips Used for Fastening Membrane and Insulation: Steel with galvalume coating; comply with FM 4470 criteria for corrosion resistance.
- O. Termination Bars: Aluminum bars with integral caulk ledge; 1.3 inches wide by 0.1 inch thick.
 - 1. Product: Elevate; Termination Bar.
- P. Roof Walkway Pads: EPDM, 0.3 inch thick and 30 by 30 inches with EPDM tape adhesive strips laminated to bottom.
 - 1. Product: Elevate; QuickSeam Walkway Pads.

2.04 COVER BOARDS

- A. High-Density Polyisocyanurate Cover Board: Water-resistant, high-density, closed-cell polyisocyanurate core with coated glass mat facers complying with ASTM C1289, Type II, Class 4 and the following characteristics:
 - 1. Thermal Value: R-value of 2.5, when tested in accordance with ASTM C518 and ASTM C177.
 - 2. Surface Water Absorption by Volume: 3 percent, maximum, when tested in accordance with ASTM C209.
 - 3. Compressive Strength: Grade 1, 120 psi, when tested in accordance with ASTM D1621.
 - 4. Density: 5 pcf, when tested in accordance with ASTM D1622.
 - 5. Factory Mutual approved for use with FM 1-60 and 1-90 rated roofing assemblies.
 - 6. Mold Growth Resistance: Zero growth, when tested in accordance with ASTM D3273 for minimum of four weeks.
 - 7. Product: Elevate; ISOGARD HD Cover Board.

2.05 INSULATION

- A. Polyisocyanurate Board Insulation: Closed-cell polyisocyanurate foam laminated to facers, complying with ASTM C1289, Type II, Class 1, with the following additional characteristics:
 - 1. Compressive Strength: 20 psi when tested in accordance with ASTM D1621.
 - 2. Ozone Depletion Potential: Zero; made without CFC- or HCFC-blowing agents.
 - 3. Mold Growth Resistance: Zero growth, when tested in accordance with ASTM D3273 for minimum of four weeks.
 - 4. Product:
 - a. Elevate; ISO 95+ GL.
- B. Insulation Fasteners: Type and size as required by roof membrane manufacturer for roofing system and warranty; use only fasteners furnished by roof membrane manufacturer.

2.06 ACCESSORIES

- A. Wood Nailers: PS 20 dimension lumber, Structural Grade No.2 or higher-grade, Southern Pine, Douglas Fir, or PS 1 APA Exterior Grade plywood; pressure preservative treated.
 - 1. Do not use asphaltic or creosote-treated lumber.
 - 2. Do not use lumber treated with wood preservatives, such as pentachlorophenol, copper naphthenate, or copper 8-quinolinolate.
 - 3. Width: 3-1/2 inches, nominal minimum, or as wide as nailing flange of roof accessory attached.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine roof deck to determine deck is sufficiently rigid to support installers and mechanical equipment so deflection will not strain or rupture roof components or deform deck.
- B. Verify surfaces and site conditions are ready to receive work. Correct defects in substrate before commencing with roofing work.

- C. Examine roof substrate to verify adequate slope to drains.
- D. Verify specifications and drawing details are workable and not in conflict with roofing manufacturer's recommendations and instructions; start of work constitutes acceptable project conditions and requirements.

3.02 PREPARATION - GENERAL

- A. Remove existing roof system down to roof deck, including existing composition base flashings. Dispose of materials in accordance with federal, state, and local regulations.
 - 1. At penetrations, remove existing flashings, including lead, asphalt, and mastic.
 - 2. At walls, curbs, and other vertical and sloped surfaces, remove loose and unsecured flashings; remove mineral surfaced and coated flashings; remove excessive asphalt to provide smooth, sound surface for new flashings.
- B. Take appropriate measures to ensure fumes from adhesive solvents are not drawn into building through air intakes.
- C. Before proceeding, ensure roof surface is clean, dry, and smooth and free of sharp edges, fins, roughened surfaces, loose or foreign materials, oil, grease, and other materials that may damage membrane.
- D. Fill surface voids in immediate substrate greater than 1/4-inch wide with fill material insulation approved by insulation and membrane manufacturers.
- E. Wood Nailers: Provide wood nailers at perimeters and other locations where indicated on drawings.
 - 1. Install with 1/8-inch gap between each length and at each change of direction.
- F. Protect adjacent construction, property, vehicles, and persons from damage related to roofing work; repair or restore damage caused by roofing work.
 - 1. Protect from spills and overspray from bitumen, adhesives, sealants, and coatings.
 - 2. Protect metal, glass, plastic, and painted surfaces from bitumen, adhesives, and sealants within range of windborne overspray.
 - 3. Protect finished areas of roofing system from roofing-related work traffic and traffic by other trades.

3.03 PREPARATION - METAL DECK

- A. Install deck sheathing on metal deck.
 - 1. Lay with long side at right angle to flutes; stagger end joints; provide support at ends.
 - 2. Cut and install deck sheathing to provide smooth and flat surface.
 - 3. Mechanically fasten deck sheathing to roof deck in accordance with roofing manufacturer's instructions.

3.04 INSTALLATION - GENERAL

- A. Install roofing, insulation, flashings, and accessories in accordance with roofing manufacturer's published instructions and recommendations for specified roofing system. Where manufacturer provides no instructions or recommendations, follow NRCA (RM) written requirements and industry standards. Comply with federal, state, and local regulations.
- B. Obtain relevant instructions and maintain copies at project site for duration of installation period.
- C. Provide temporary closures to ensure moisture does not damage completed roofing. Use flashings, terminations, and temporary closures to provide watertight installation.

3.05 INSTALLATION - INSULATION

- A. Install insulation in accordance with manufacturer's written instructions.
- B. Install only as much insulation as can be covered with completed roofing system before end of day's work or before onset of inclement weather.
- C. Lay roof insulation in courses parallel to roof edges.

- D. Neatly and tightly fit insulation to penetrations, projections, and nailers, with gaps not greater than 1/4 inch. Fill gaps greater than 1/4 inch with acceptable insulation. Do not leave roofing membrane unsupported over space greater than 1/4 inch.
- E. Mechanical Fastening: Using specified fasteners and insulation plates, engage fasteners through insulation into deck to depth and in pattern required by membrane manufacturer.
 1. Comply with specified Factory Mutual for FM Class requirements.

3.06 INSTALLATION - COVER BOARD

- A. Install in accordance with membrane manufacturer's instructions and recommendations.
- B. Cold Adhesive Attachment: Apply pressure to individual boards to obtain maximum adhesive contact.

3.07 INSTALLATION - SINGLE-PLY MEMBRANE

- A. Beginning at low point of roof, place membrane without stretching over substrate and allow to relax before attachment or splicing. Refer to membrane manufacturer's guidelines for minimum relaxation time.
- B. Lay out membrane pieces so field and flashing splices are installed to shed water.
- C. Install membrane without wrinkles and without gaps or fishmouths in seams; bond and test seams and laps in accordance with membrane manufacturer's instructions and details.
- D. Adhered Membrane: Bond membrane sheet to substrate using membrane manufacturer's recommended bonding material, application rate, and procedures.
- E. Edge Securement: Secure membrane at locations where membrane terminates or goes through angle change greater than 2 in 12 inches using mechanically-fastened reinforced perimeter fastening strips, plates, or metal edging as indicated in drawings, or as recommended by roofing manufacturer.
 1. Exceptions: Round pipe penetrations less than 18 inches in diameter and square penetrations less than 4 inches wide.
- F. Existing Roofing: Tie new roofing into existing roofing systems as recommended by manufacturer to avoid nullification of existing roofing warranty. Provide and install compatible materials required for complete and watertight installation.

3.08 INSTALLATION - FLASHING AND ACCESSORIES

- A. Install flashings, including laps, splices, joints, bonding, adhesion, and attachment, as required by membrane manufacturer's recommendations and details.
- B. Metal Accessories: Install metal edgings, gravel stops, and copings in locations indicated on drawings, with horizontal leg of edge member over membrane, and flashing over metal onto membrane.
 1. Follow roofing manufacturer's instructions.
 2. Remove protective plastic surface film immediately before installation.
 3. Install water block sealant under membrane anchorage leg.
 4. Flash with manufacturer's recommended flashing sheet.
 5. Where single flashing application does not completely cover metal flange, install additional flashing piece to cover metal edge.
 6. If roof edge includes gravel stop and sealant is not applied between laps in metal edging, install additional piece of self-adhesive flashing membrane over metal lap to top of gravel stop; apply seam edge treatment at intersections of two flashing sections.
 7. When roof slope is greater than 1 inch per foot, apply seam edge treatment along back edge of flashing.
- C. Existing Scuppers: Remove scupper and install new scupper.
- D. Install weathertight flashing at walls, curbs, parapets, curbs, skylights, and other vertical and sloped surfaces.
 1. Extend flashing minimum 8 inches above membrane surface unless otherwise noted on

- drawings.
2. Use longest practical flashing pieces.
 3. Evaluate substrate and overlay; adjust installation procedure in accordance with membrane manufacturer's recommendations.
 4. Complete splices between flashing and main roof sheet with specified splice adhesive before adhering flashing to vertical surfaces.
- E. Roof Drains:
1. Existing Drains: Remove existing flashings, drain leads, roofing materials, and cement from drain; remove clamping ring.
 2. Taper insulation around drain to provide smooth transition from roof surface to drain. Use specified premanufactured tapered insulation with facer or suitable bonding surface to achieve slope; slope not to exceed manufacturer's recommendations.
 3. Position membrane, then cut hole for roof drain to allow 1/2 to 3/4 inch of membrane to extend inside clamping ring past drain bolts.
 4. Make round holes in membrane to align with clamping bolts; do not cut membrane back to bolt holes.
 5. Apply sealant on top of drain bowl where clamping ring seats below membrane.
 6. Install roof drain clamping ring and clamping bolts; tighten clamping bolts to achieve constant compression.
- F. Flash penetrations passing through membrane; make flashing seals directly to penetration.
1. Pipes, Round Supports, and Similar Items: Flash with specified premolded pipe flashings wherever practical; otherwise, use specified self-curing elastomeric flashing.
 2. Pipe Clusters and Unusual Shaped Penetrations: Provide penetration pocket at least 2 inches deep, with at least 1-inch clearance from penetration; fill with manufacturer's pourable sealer and slope to shed water.
 3. Structural Steel Tubing: If corner radii are greater than 1/4 inch and longest side of tube does not exceed 12 inches, flash as for pipes; otherwise, provide standard curb with flashing.
 4. Flexible and Moving Penetrations: Provide weathertight gooseneck set in sealant and secured to deck, flashed as recommended by manufacturer.

3.09 INSTALLATION - FINISHING AND WALKWAYS

- A. Install walkways at access points to roof, around rooftop equipment requiring maintenance, and where indicated on drawings.
1. Do not install walkway pads within 10 feet of roof edge or perimeter.
- B. Walkway Pads: Adhere to roofing membrane, spacing each pad at minimum of 1 inch and maximum of 3 inches from each other to allow for drainage.
1. If installation of walkway pads over field-fabricated splices or within 6 inches of splice edge cannot be avoided, adhere another layer of flashing over splice and extending beyond walkway pad minimum of 6 inches on either side.
 2. Prime membrane, remove release paper on pad, press in place, and walk on pad to ensure adhesion.

3.10 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements for additional requirements.
- B. Inspection by Manufacturer: Provide final inspection of roofing system by technical representative employed by roofing system manufacturer to inspect installation for warranty purposes, not a sales person.
- C. Perform corrections necessary for issuance of warranty.
- D. Repair or replace building components and finished surfaces damaged or defaced due to work of this section; comply with recommendations of manufacturers of components and surfaces.

3.11 CLEANING

- A. Clean contaminants generated by roofing work from building and surrounding areas, including bitumen, adhesives, sealants, and coatings.
- B. Remove leftover materials, trash, debris, and equipment from project site and surrounding areas.

3.12 PROTECTION

- A. Where construction traffic continues over finished roof panels, provide durable protection and replace or repair damaged roofing to original condition.

END OF SECTION

**SECTION 076200
SHEET METAL FLASHING AND TRIM**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings, counterflashings, gutters, and downspouts.
- B. Sealants for joints within sheet metal fabrications.
- C. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Wood nailers for sheet metal work.
- B. Section 075323 - Ethylene-Propylene-Diene-Monomer Roofing (EPDM): Non-metallic flashings associated with membrane roofing.
- C. Section 079200 - Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.

1.03 REFERENCE STANDARDS

- A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ANSI/SPRI/FM 4435/ES-1 - Test Standard for Edge Systems Used with Low Slope Roofing Systems; 2022.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- E. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).
- F. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- C. Samples: Submit two samples 3x4 inch in size illustrating metal finish color.

1.05 QUALITY ASSURANCE

- A. Perform work in accordance with CDA A4050, SMACNA (ASMM), CDA A4050, and SMACNA (ASMM) requirements and standard details, except as otherwise indicated.
- B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with 5 years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

- A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 22 gage, (0.0299) inch thick base metal.
- B. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24

gage, (0.0239) inch thick base metal, shop pre-coated with PVDF coating.

1. Modified Silicone Polyester Coating: Pigmented Organic Coating System, AAMA 2603; baked enamel finish system.
2. Color: To match approved sample.

2.02 ACCESSORIES

- A. Metal Roof Edging and Fascia: Continuous metal edge member serving as termination of roof membrane and retainer for metal fascia; watertight with no exposed fasteners; mounted to roof edge nailer.
 1. Wind Performance:
 - a. Membrane Pull-Off Resistance: 100 lb/ft, minimum, when tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-1.
 - b. Fascia Pull-Off Resistance: At least minimum required when tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-2.
 2. Profile: Match existing.
 3. Fascia Material and Finish: 24-gauge, 0.024-inch galvanized steel with Kynar 500 finish in manufacturer's standard color; matching concealed joint splice plates; factory-installed protective plastic film.
 4. Length: 144 inches.
 5. Anchor Bar Cleat: 20-gauge, 0.036-inch galvanized steel with prepunched holes.
 6. Fasteners: Factory-provided corrosion-resistant fasteners with drivers; no exposed fasteners permitted.
 7. Special Shaped Components: Provide factory-fabricated pieces necessary for complete installation, including miters, scuppers, and end caps; minimum 14-inch long legs on corner pieces.
 - a. Scuppers: Welded watertight.
- B. Parapet Copings: Formed metal coping with galvanized steel anchor and support cleats for capping parapet wall; watertight, maintenance free, without exposed fasteners; butt-type joints with concealed splice plates; mechanically fastened as indicated; Elevate PTCF.
 1. Wind Performance:
 - a. At least minimum required when tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-3.
 2. Profile: Match existing.
 3. Material and Finish: 24-gauge, 0.024-inch thick galvanized steel with Kynar 500 finish in manufacturer's standard color; matching concealed joint splice plates; factory-installed protective plastic film.
 4. Dimensions:
 - a. Wall Width: As indicated on drawings.
 - b. Length: 144 inches, minimum.
 5. Anchor or Support Cleats: 20-gauge, 0.036-inch thick prepunched galvanized cleat with 12-inch wide stainless steel spring mechanically locked to cleat at 72 inches on center.
 6. Special Shaped Components: Provide factory-fabricated pieces necessary for complete installation, including miters, corners, intersections, curves, pier caps, and end caps; minimum 14-inch long legs on corner, intersection, and end pieces.
 7. Fasteners: Factory-provided corrosion-resistant fasteners, with drivers; no exposed fasteners permitted.
- C. Primer: Zinc chromate type.
- D. Protective Backing Paint: Zinc molybdate alkyd.
- E. Sealant to be Concealed in Completed Work: Non-curing butyl sealant.
- F. Sealant to be Exposed in Completed Work: ASTM C920; elastomeric sealant, 100 percent silicone with minimum movement capability of plus/minus 25 percent and recommended by manufacturer for substrates to be sealed; clear.

- G. Plastic Cement: ASTM D4586, Type I.

2.03 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.
- F. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

2.04 ACCESSORIES

- A. Fasteners: Galvanized steel, with soft neoprene washers.
- B. Primer: Zinc chromate type.
- C. Concealed Sealants: Non-curing butyl sealant.
- D. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
- E. Plastic Cement: ASTM D4586/D4586M, Type I.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.03 INSTALLATION

- A. Insert flashings into reglets to form tight fit; secure in place with lead wedges; pack remaining spaces with lead wool; seal flashings into reglets with sealant.
- B. Secure flashings in place using concealed fasteners. Use exposed fasteners only where permitted.
- C. Apply plastic cement compound between metal flashings and felt flashings.
- D. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- E. Seal metal joints watertight.
- F. Set splash pads under downspouts.

3.04 FIELD QUALITY CONTROL

- A. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

SECTION 078400 FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

1.02 RELATED REQUIREMENTS

- A. Section 092116 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.03 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
- C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).
- D. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2023b.
- E. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2023a.
- F. ITS (DIR) - Directory of Listed Products; Current Edition.
- G. FM 4991 - Approval Standard of Firestop Contractors; 2013.
- H. FM (AG) - FM Approval Guide; Current Edition.
- I. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Current Edition, Including All Revisions.
- J. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance ratings, and limitations.
- C. Manufacturer's Installation Instructions: Indicate preparation and installation instructions.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
 - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
 - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
 - 3. Submission of actual test reports is required for assemblies for which none of the above substantiation exists.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section and:
 - 1. Approved by Factory Mutual Research Corporation under FM 4991, or meeting any two of the following requirements:

2. Verification of minimum three years documented experience installing work of this type.
3. Verification of at least five satisfactorily completed projects of comparable size and type.
4. Licensed by local authorities having jurisdiction (AHJ).

1.06 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.
- B. Provide ventilation in areas where solvent-cured materials are being installed.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Manufacturers:
 1. A/D Fire Protection Systems Inc.: www.adfire.com.
 2. 3M Fire Protection Products: www.3m.com/firestop.
 3. Hilti, Inc: www.us.hilti.com/#sle.
 4. Nelson FireStop Products: www.nelsonfirestop.com.
 5. Specified Technologies, Inc.: www.stifirestop.com.
- B. Firestopping Materials: Any materials meeting requirements.
- C. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.
- D. Fire Ratings: Refer to drawings for required systems and ratings.

2.02 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Perimeter Fire Containment Firestopping: Use system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of floor assembly.
- B. Head-of-Wall Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
- C. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Except Perimeter, Where Both Are Fire-Rated: Use system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
- D. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

2.03 FIRESTOPPING FOR FLOOR-TO-FLOOR, WALL-TO-FLOOR, AND WALL-TO-WALL JOINTS

- A. Concrete and Concrete Masonry Walls and Floors:
 1. Floor to Floor Joints:
 - a. 2 Hour Construction: UL System FF-D-1085; Tremco, TREMstop Acrylic Firestop Sealant.
 2. Top of Wall Joints at Concrete/Concrete Masonry Wall to Concrete Floor:
 - a. 2 Hour Construction: UL System HW-D-0268; Hilti CP 606 Flexible Firestop Sealant.
 3. Concrete/Concrete Masonry Wall to Wall Joint Systems That Have Movement Capabilities (Dynamic):
 - a. 2 Hour Construction: UL System WW-D-0032; Hilti CP 606 Flexible Firestop Sealant.
- B. Gypsum Board Walls:
 1. Wall to Wall Joints That Have Movement Capabilities (Dynamic):
 - a. 1 Hour Construction: UL System WW-D-0067; Hilti CP 606 Flexible Firestop Sealant.

2.04 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS

- A. Blank Openings:
 1. 1 Hour Construction: UL System W-L-3334; Hilti CP 653 Speed Sleeve.

- B. Penetrations By:
 - 1. Multiple Penetrations in Large Openings:
 - a. 1 Hour Construction: UL System W-L-1408; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - b. 1 Hour Construction: UL System W-L-8013; Hilti CFS-BL Firestop Block.
 - 2. Uninsulated Metallic Pipe, Conduit, and Tubing:
 - a. 1 Hour Construction: UL System W-L-1054; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - 3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
 - a. 1 Hour Construction: UL System W-L-2128; Hilti FS-ONE MAX Intumescent Firestop Sealant.
 - 4. Electrical Cables Not In Conduit:
 - a. 1 Hour Construction: UL System W-L-3065; Hilti FS-ONE MAX Intumescent Firestop Sealant, CP 606 Flexible Firestop Sealant, CD 601S Elastomeric Firestop Sealant, or CP 618 Firestop Putty Stick.
 - 5. Insulated Pipes:
 - a. 1 Hour Construction: UL System W-L-5028; Hilti FS-ONE MAX Intumescent Firestop Sealant.

2.05 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.
 - 1. Fire Ratings: See drawings for required systems and ratings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- C. Install labeling required by code.

3.04 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.05 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 079200 JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 092116 - Gypsum Board Assemblies: Sealing acoustical and sound-rated walls and ceilings.
- B. Section 093000 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.

1.03 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).
- B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).
- C. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
- D. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2022.
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- F. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- G. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.
- H. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2022.
- I. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2023.
- J. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).
- K. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).
- L. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2022.
- M. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- N. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
 - 5. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
- C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color

cards showing standard colors available for selection.

- D. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.
- E. Manufacturer's qualification statement.
- F. Installer's qualification statement.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Nonsag Sealants:
 - 1. Bostik Inc: www.bostik-us.com/#sle.
 - 2. Dow: www.dow.com/#sle.
 - 3. Hilti, Inc: www.hilti.com/#sle.
 - 4. Pecora Corporation: www.pecora.com/#sle.
 - 5. Sika Corporation: www.usa.sika.com/#sle.
 - 6. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
 - 7. W.R. Meadows, Inc: www.wrmeadows.com/#sle.
 - 8. Substitutions: See Section 016000 - Product Requirements.
- B. Self-Leveling Sealants:
 - 1. Bostik Inc: www.bostik-us.com/#sle.
 - 2. Dow: www.dow.com/#sle.
 - 3. Pecora Corporation: www.pecora.com/#sle.
 - 4. Sika Corporation: www.usa.sika.com/#sle.
 - 5. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
 - 6. W.R. Meadows, Inc: www.wrmeadows.com/#sle.
 - 7. Substitutions: See Section 016000 - Product Requirements.

2.02 JOINT SEALANT APPLICATIONS

- A. Scope:
 - 1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to:
 - a. Wall expansion and control joints.
 - b. Joints between door, window, and other frames and adjacent construction.
 - c. Joints between different exposed materials.
 - d. Openings below ledge angles in masonry.
 - e. Other joints indicated below.
 - 2. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
 - c. Other joints indicated below.
 - 3. Do not seal the following types of joints:
 - a. Intentional weep holes in masonry.
 - b. Joints indicated to be treated with manufactured expansion joint cover, or some other

- type of sealing device.
 - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - d. Joints where installation of sealant is specified in another section.
 - e. Joints between suspended panel ceilings/grid and walls.
- B. Exterior Joints: Use nonsag nonstaining silicone sealant, unless otherwise indicated.
 - 1. Lap Joints in Sheet Metal Fabrications: Butyl rubber, noncuring.
 - 2. Lap Joints between Manufactured Metal Panels: Butyl rubber, noncuring.
 - 3. Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane traffic-grade sealant.
- C. Interior Joints: Use nonsag polyurethane sealant, unless otherwise indicated.
 - 1. Wall and Ceiling Joints in Nonwet Areas: Acrylic emulsion latex sealant.
 - 2. Wall and Ceiling Joints in Wet Areas: Nonsag polyurethane sealant for continuous liquid immersion.
 - 3. Floor Joints in Wet Areas: Nonsag polyurethane non-traffic-grade sealant suitable for continuous liquid immersion.
 - 4. Joints between Tile in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
 - 5. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
 - 6. Narrow Control Joints in Interior Concrete Slabs: Self-leveling epoxy sealant.
 - 7. Other Floor Joints: Self-leveling polyurethane traffic-grade sealant.
- D. Interior Wet Areas: Bathrooms, restrooms, kitchens, food service areas, and food processing areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.
- E. Sound-Rated Assemblies: Walls and ceilings identified as STC-rated, sound-rated, or acoustical.

2.03 NONSAG JOINT SEALANTS

- A. Nonstaining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
 - 1. Movement Capability: Plus and minus 35 percent, minimum.
 - 2. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
 - 3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
 - 4. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
 - 5. Color: To be selected by Architect from manufacturer's full range.
 - 6. Service Temperature Range: Minus 20 to 180 degrees F.
 - 7. Products:
 - a. Dow: www.dow.com/#sle.
 - b. Pecora Corporation: www.pecora.com/#sle.
 - c. Sika Corporation: www.usa.sika.com/#sle.
 - d. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
 - e. Substitutions: See Section 016000 - Product Requirements.
- B. Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
 - 1. Movement Capability: Plus and minus 25 percent, minimum.
 - 2. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
 - 3. Color: To be selected by Architect from manufacturer's full range.
 - 4. Cure Type: Single component, neutral moisture curing.
 - 5. Service Temperature Range: Minus 65 to 180 degrees F.
 - 6. Products:
 - a. Dow: www.dow.com/#sle.

- b. Pecora Corporation: www.pecora.com/#sle.
 - c. Sika Corporation: www.usa.sika.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- C. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
 - 1. Color: To be selected by Architect from manufacturer's full range..
 - 2. Products:
 - a. Pecora Corporation: www.pecora.com/#sle.
 - b. Sika Corporation: www.usa.sika.com/#sle.
 - c. Substitutions: See Section 016000 - Product Requirements.
- D. Hybrid Elastomeric Sealant: ASTM C920, Grade NS, Uses M and A; single component; not expected to withstand continuous water immersion or traffic.
 - 1. Movement Capability: Plus and minus 50 percent, minimum.
 - 2. Hardness Range: 15 to 25, Shore A, when tested in accordance with ASTM C661.
 - 3. Color: To be selected by Architect from manufacturer's full range.
 - 4. Service Temperature Range: Minus 75 to 300 degrees F.
 - 5. Products:
 - a. Dow: www.dow.com/#sle.
 - b. Tremco Commercial Sealants and Waterproofing: www.tremcosealants.com/#sle.
 - c. Substitutions: See Section 016000 - Product Requirements.
- E. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
 - 1. Movement Capability: Plus and minus 35 percent, minimum.
 - 2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
 - 3. Color: To be selected by Architect from manufacturer's full range.
 - 4. Service Temperature Range: Minus 40 to 180 degrees F.
 - 5. Products:
 - a. Pecora Corporation: www.pecora.com/#sle.
 - b. Sika Corporation: www.usa.sika.com/#sle.
 - c. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
 - d. W. R. Meadows, Inc: www.wrmeadows.com/#sle.
 - e. Substitutions: See Section 016000 - Product Requirements.
- F. Polyurethane Sealant for Continuous Water Immersion: ASTM C920, Grade NS, Uses M and A; single or multicomponent; explicitly approved by manufacturer for continuous water immersion; suitable for traffic exposure when recessed below traffic surface.
 - 1. Movement Capability: Plus and minus 35 percent, minimum.
 - 2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
 - 3. Color: To be selected by Architect from manufacturer's standard range.
 - 4. Service Temperature Range: Minus 40 to 180 degrees F.
 - 5. Products:
 - a. Sika Corporation: www.usa.sika.com/#sle.
- G. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, nonstaining, nonbleeding, nonsagging; not intended for exterior use.
 - 1. Color: Standard colors matching finished surfaces, Type OP (opaque).
 - 2. Grade: ASTM C834; Grade 0 Degrees F (Minus 18 Degrees C).
 - 3. Products:
 - a. Hilti, Inc: www.us.hilti.com/#sle.
 - b. Pecora Corporation: www.pecora.com/#sle.
 - c. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- H. Type ___ - Noncuring Butyl Sealant: Solvent-based, single component, nonsag, nonskinning,

nonhardening, nonbleeding; non-vapor permeable; intended for fully concealed applications.

2.04 SELF-LEVELING JOINT SEALANTS

- A. Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion .
 - 1. Movement Capability: Plus and minus 25 percent, minimum.
 - 2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
 - 3. Color: To be selected by Architect from manufacturer's standard range.
 - 4. Service Temperature Range: Minus 40 to 180 degrees F.
 - 5. Products:
 - a. Pecora Corporation: www.pecora.com/#sle.
 - b. Sika Corporation: www.usa.sika.com/#sle.
 - c. Substitutions: See Section 016000 - Product Requirements.

- B. Self-Leveling Polyurethane Sealant for Continuous Water Immersion: Polyurethane; ASTM C920, Grade P, Uses M and A; single component; explicitly approved by manufacturer for traffic exposure and continuous water immersion.
 - 1. Movement Capability: Plus and minus 25 percent, minimum.
 - 2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
 - 3. Color: To be selected by Architect from manufacturer's standard range.
 - 4. Service Temperature Range: Minus 40 to 180 degrees F.
 - 5. Products:
 - a. Sika Corporation: www.usa.sika.com/#sle.
 - b. W. R. MEADOWS, Inc: www.wrmeadows.com/#sle.
 - c. _____.

- C. Semi-Rigid Self-Leveling Epoxy Joint Filler: Epoxy or epoxy/polyurethane copolymer; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
 - 1. Composition: Multicomponent, 100 percent solids by weight.
 - 2. Durometer Hardness: Minimum of 85 for Type A or 35 for Type D, after seven days when tested in accordance with ASTM D2240.
 - 3. Color: To be selected by Architect from manufacturer's standard colors.
 - 4. Joint Width, Minimum: 1/8 inch.
 - 5. Joint Depth: Provide product suitable for joints from 1/8 inch to 2 inches in depth including space for backer rod.
 - 6. Products:
 - a. W.R. Meadows, Inc: www.wrmeadows.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.05 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
 - 1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
 - 2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
 - 3. Open Cell: 40 to 50 percent larger in diameter than joint width.
 - 4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
 - 5. Products:
 - a. Adfast USA Inc: www.adfastcorp.com/#sle.
 - b. Nomaco, Inc: www.nomaco.com/#sle.
 - c. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.
- E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in an inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

- A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Provide joint sealant installations complying with ASTM C1193.
- C. Install acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:
 - 1. Width/depth ratio of 2:1.
 - 2. Neck dimension no greater than 1/3 of the joint width.
 - 3. Surface bond area on each side not less than 75 percent of joint width.
- E. Install bond breaker backing tape where backer rod cannot be used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
- I. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

END OF SECTION

**SECTION 081113
HOLLOW METAL DOORS AND FRAMES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Fire-rated hollow metal doors and frames.
- D. Thermally insulated hollow metal doors with frames.
- E. Hollow metal borrowed lites glazing frames.

1.02 RELATED REQUIREMENTS

- A. Section 087100 - Door Hardware.
- B. Section 088000 - Glazing: Glass for doors and borrowed lites.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2024.
- D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
- E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
- H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- I. ASTM C1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus; 2011.
- J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- K. NAAMM HMMA 840 - Guide Specifications for Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2024.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

1.05 QUALITY ASSURANCE

- A. Maintain at project site copies of reference standards relating to installation of products specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
 - 1. Curries, an Assa Abloy Group company: www.assaabloydss.com/#sle.
 - 2. De La Fontaine Inc: www.delafontaine.com/#sle.
 - 3. De La Fontaine Inc: www.delafontaine.com.
 - 4. De La Fontaine Inc: www.delafontaine.com.
 - 5. Republic Doors: www.republicdoor.com.
 - 6. Steelcraft, an Allegion brand: www.allegion.com/#sle.
 - 7. Substitutions: See Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
 - 1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
 - 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 3. Finish: Factory primed, for field finishing.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. Exterior Doors: Thermally insulated.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 1 - Standard-duty.
 - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 20 gage, 0.032 inch, minimum.
 - 2. Door Thickness: 1-3/4 inch, nominal.
 - 3. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvanized) in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness.
 - 4. Insulating Value: U-value of 0.50, when tested in accordance with ASTM C1363.
- B. Interior Doors, Non-Fire-Rated:
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 1 - Standard-duty.
 - b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 1 - Full Flush.
 - d. Door Face Metal Thickness: 20 gage, 0.032 inch, minimum.
 - 2. Door Thickness: 1-3/4 inch, nominal.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

- B. General:
 - 1. Comply with the requirements of grade specified for corresponding door.
 - a. Frames for Wood Doors: Comply with frame requirements in accordance with ANSI/SDI A250.8 (SDI-100), Level 1, 18 gage, 0.042 inch, minimum thickness.
 - 2. Finish: Same as for door.
 - 3. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
- C. Exterior Door Frames: Full profile/continuously welded type.
 - 1. Weatherstripping: Separate, see Section 087100.
- D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
- E. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
- F. Mullions for Pairs of Doors: Fixed, with profile similar to jambs.
- G. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.06 ACCESSORIES

- A. Glazing: As specified in Section 088000, factory installed.
- B. Grout for Frames: Portland cement grout with maximum 4 inch slump for hand troweling; thinner pumpable grout is prohibited.
- C. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- D. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

2.07 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Coordinate frame anchor placement with wall construction.
- C. Install door hardware as specified in Section 087100.
- D. Comply with glazing installation requirements of Section 088000.

3.04 TOLERANCES

- A. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.05 ADJUSTING

- A. Adjust for smooth and balanced door movement.

3.06 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

**SECTION 081416
FLUSH WOOD DOORS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush wood doors; flush and flush glazed configuration; fire rated and non-rated.

1.02 RELATED REQUIREMENTS

- A. Section 081113 - Hollow Metal Doors and Frames.
- B. Section 087100 - Door Hardware.
- C. Section 088000 - Glazing.

1.03 REFERENCE STANDARDS

- A. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- D. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2025.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
- D. Specimen warranty.
- E. Samples: Submit two samples of door veneer, 6 by 6 inch in size illustrating wood grain, stain color, and sheen.
- F. Manufacturer's Installation Instructions: Indicate special installation instructions.
- G. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Interior Doors: Provide manufacturer's warranty for the life of the installation.
- C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wood Veneer Faced Doors:
 - 1. Graham Wood Doors: www.grahamdoors.com.
 - 2. VT Industries.
 - 3. Substitutions: See Section 016000 - Product Requirements.

2.02 DOORS AND PANELS

- A. Doors: Refer to drawings for locations and additional requirements.
 - 1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
 - 2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
 - 1. Provide solid core doors at each location, _____.
 - 2. Wood veneer facing with factory transparent finishmatching sample provided by Architect.

2.03 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type particleboard core (PC), plies and faces as indicated.

2.04 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: Red oak, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with book match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face.

2.05 ACCESSORIES

- A. Glazed Openings:
 - 1. Heat-Strengthened and Fully Tempered Glass: {rs\#1}.
 - 2. Glazing: Single vision units, 1/4 inch glass.
 - 3. Tint: Clear.
- B. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.
- C. Astragals for Non-Rated Double Doors: Steel, T shaped, overlapping and recessed at face edge.

2.06 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
 - 1. Provide solid blocks at lock edge for hardware reinforcement.
 - 2. Provide solid blocking for other throughbolted hardware.
- C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- E. Provide edge clearances in accordance with the quality standard specified.

2.07 FACTORY FINISHING - WOOD VENEER DOORS

- A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
 - 1. Transparent:
 - a. System - 1, Lacquer, Nitrocellulose.
 - b. Sheen: Flat.

- B. Factory finish doors in accordance with sample to be provided.

2.08 ACCESSORIES

- A. Hollow Metal Door Frames: See Section 081113.
- B. Glazing: See Section 088000.
- C. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.

3.03 TOLERANCES

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

END OF SECTION

**SECTION 084313
ALUMINUM-FRAMED STOREFRONTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Infill panels of glass.
- C. Aluminum doors and frames.
- D. Weatherstripping.
- E. Door hardware.
- F. Perimeter sealant.

1.02 RELATED REQUIREMENTS

- A. Section 078400 - Firestopping: Firestop at system junction with structure.
- B. Section 079200 - Joint Sealants: Sealing joints between frames and adjacent construction.
- C. Section 084413 - Glazed Aluminum Curtain Walls.
- D. Section 087100 - Door Hardware: Hardware items other than specified in this section.
- E. Section 088000 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
- B. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.
- C. AAMA 611 - Specification for Anodized Architectural Aluminum; 2024.
- D. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
- E. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- G. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- H. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- I. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- J. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- K. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.

- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
 - 1. Include design engineer's stamp or seal on shop drawings for attachments and anchors.
- D. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- E. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.
- F. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
- G. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- H. Designer's Qualification Statement.
- I. Manufacturer's Qualification Statement.
- J. Installer's Qualification Statement.
- K. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.09 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide twenty year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 MANUFACTURERS

- A. Aluminum-Framed Storefront and Doors: basis of Design: Kawneer North America 451T.
 - 1. Manko Window Systems, Inc: www.mankowindows.com.
 - 2. Tubelite, Inc: www.tubeliteinc.com.
 - 3. Substitutions: See Section 016000 - Product Requirements.

2.03 STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members

with infill, and related flashings, anchorage and attachment devices.

1. Glazing Position: Front-set.
 2. Vertical Mullion Dimensions: 2 inches wide by 6 inches deep.
 3. Finish: High performance organic coatings.
 4. Finish Color: Dark bronze.
 5. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 6. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 7. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 8. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 9. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 10. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
- B. Performance Requirements:
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
 2. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 6.66 psf
 3. Air Leakage Laboratory Test: Maximum of 0.09 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.24 psf pressure differential across assembly.
 4. Condensation Resistance Factor of Framing: 63, minimum, measured in accordance with AAMA 1503.
 5. Overall U-value Including Glazing: 0.36 Btu/(hr sq ft deg F), maximum.

2.04 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Framing members for interior applications need not be thermally broken.
 2. Glazing Stops: Flush.
 3. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
- B. Glazing: As specified in Section 088000.
- C. Swing Doors: Glazed thermally broken aluminum.
1. Thickness: 1-3/4 inches.
 2. Top Rail: 6 inches wide.
 3. Vertical Stiles: 6 inches wide.
 4. Bottom Rail: 12 inches wide.
 5. Glazing Stops: Square.
 6. Finish: Same as storefront.

2.05 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).

- B. Sheet Aluminum: ASTM B209 (ASTM B209M).
- C. Fasteners: Stainless steel.
- D. Exposed Flashings: Aluminum sheet, 20 gage, 0.032 inch minimum thickness; finish to match framing members.
- E. Concealed Flashings: Sheet aluminum, 26 gage, 0.017 inch minimum thickness.
- F. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, compatible with flashing material.
- G. Sealant for Setting Thresholds: Non-curing butyl type.
- H. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- I. Glazing Accessories: As specified in Section 088000.

2.06 FINISHES

- A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

2.07 HARDWARE

- A. For each door, include weatherstripping, sill sweep strip, and threshold.
- B. Other Door Hardware: Storefront manufacturer's standard type to suit application.
 - 1. Finish on Hand-Contacted Items: Polished chrome.
 - 2. For each door, include pivots, push handle, pull handle, exit device, narrow stile handle latch, and closer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Set thresholds in bed of sealant and secure.
- K. Install hardware using templates provided.
- L. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet,

whichever is less.

- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections.
 - 1. ASTM E1105, ASTM E238/E238M and AAMA 501.2 Water/Air testing. Contractor to assist with testing by providing safe access, water, power, chamber materials and personnel to perform the tests. If failure occurs provide additional test assistance as needed to pass test at no additional cost.
- B. Water Penetration Testing: Perform four tests ASTM E1105. Test specimen sizes will be no larger than 10' x 10'.
 - 1. The static air pressure differential for testing shall be 6.66 psf.
 - 2. Test failure is defined as any water penetration.
- C. Air Leakage Test: Perform 4 tests in accordance with ASTM E 783. Test specimen sizes will be no larger than 10' x 10'. Test specimens will be same specimens tested during water penetration testing.
 - 1. The uniform static air pressure differential for testing shall be 6.24 psf and the allowable leakage shall be 0.09 cfm/ft².
- D. Repair or replacework if test results and inspections indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements. If any test results in failure, re-test the failed specimen and test one additional specimen for each failed test. Re-testing and additional tests shall be at Contractor's expense. No limit shall be set of the total number of tests required to verify compliance with specified performance requirements.
- F. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.
- G. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

- A. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.
- C. Remove excess sealant by method acceptable to sealant manufacturer.

3.07 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

**SECTION 087100
DOOR HARDWARE**

PART 1 - GENERAL

1.1 CONDITIONS

- A. Conditions of the contract (General and Supplementary Conditions) and Division 01 - General Requirements, govern the work of this section.
- B. This section includes all material, and related service necessary to furnish all finish hardware indicated on the drawings or specified herein.
- C. Furnish UL listed hardware for all labeled and 20 min. openings in conformance with the requirements for the class of opening scheduled. Underwriters' requirements shall have precedence over specification where conflicts exist.
- D. All work shall be in accordance with all applicable state and local building codes. Code requirements shall have precedence over this specification where conflicts exist.

1.2 WORK INCLUDED

- A. This section includes the following:
 - 1. Furnish door hardware (for hollow metal, wood and aluminum doors) specified herein, listed in the hardware schedule, and/or required by the drawings.
 - 2. Cylinders for Aluminum Doors
 - 3. Thresholds and Weather-stripping (Aluminum frame seals to be provided by aluminum door supplier)
 - 4. Electro-Mechanical Devices
 - 5. Access Control components and or systems specified within this section.
- B. Where items of hardware are not definitely or correctly specified and is required for the intended service, such omission, error or other discrepancy should be directed to the Architect prior to the bid date for clarification by addendum. Otherwise furnish such items in the type and quantity established by this specification for the appropriate service intended.

1.3 RELATED WORK IN OTHER SECTIONS

- A. This section includes coordination with related work in the following sections:
 - 1. Division 06 Section "Finish Carpentry".
 - 2. Division 06 Section "Cabinet Hardware"
 - 3. Division 08 Section "Hollow Metal Doors and Frames".
 - 4. Division 08 Section "Wood Doors"
 - 5. Division 08 Section "Storm Doors"
 - 6. Division 08 Section "Aluminum Entrances and Storefronts"
 - 7. Division 26 Sections "Electrical"
 - 8. Division 28 Sections "Electronic Safety and Security".

1.4 REFERENCES

- A. Publications of agencies and organizations listed below form a part of this specification section to the extent referenced.
 - 1. DHI – Installation Guide for Doors and Hardware (2020).
 - 2. NFPA 80 - Standards for Fire Doors and Windows.
 - 3. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.
 - 4. UL - Building Material Directory.
 - 5. DHI - Door and Hardware Institute
 - 6. WHI - Warnock Hersey
 - 7. BHMA - Builders Hardware Manufacturers Association
 - 8. ANSI – American National Standards Institute

9. IBC - International Building Code 2018 Edition (as adopted and amended by local building code)

1.5 SUBMITTALS

- A. Within ten days after award of contract, submit detailed hardware schedule in quantities as required by Division 01 - General Requirements.
- B. Schedule format shall be consistent with recommendations for a vertical format as set forth in the Door & Hardware Institute's (DHI) publication "Sequence and Format for the Hardware Schedule". Hardware sets shall be consolidated to group multiple door openings which share similar hardware requirements. Schedule shall include the following information:
 1. Door number, location, size, handing, and rating.
 2. Door and frame material, handing.
 3. Degree of swing.
 4. Manufacturer
 5. Product name and catalog number
 6. Function, type and style
 7. Size and finish of each item
 8. Mounting heights
 9. Explanation of abbreviations, symbols, etc.
 10. Numerical door index, indicating the hardware set/ group number for each door.
- C. When universal type door closers are to be provided, the schedule shall indicate the application method to be used for installation at each door: (regular arm, parallel arm, or top jamb).
- D. The schedule will be prepared under the direct supervision of a certified Architectural Hardware Consultant (AHC), or certified Door Hardware Consultant (DHC) employed by the hardware distributor. The hardware schedule shall be signed and embossed or stamped with the DHI certification seal of the supervising AHC or DHC. The supervising AHC or DHC shall attend any meetings related to the project when requested by the architect.
- E. Check the specified hardware for suitability and adaptability to the details and surrounding conditions.
- F. Review drawings from related trades as required to verify compatibility with specified hardware. Indicate unsuitable or incompatible items, and proposed substitutions in the hardware schedule.
- G. Provide documentation for all hardware to be furnished on labeled fire doors indicating compliance with positive pressure fire testing UL 10C.
- H. Furnish manufacturers' catalog data for each item of hardware in quantities as required by Division 01 - General Requirements.
- I. Submit a sample of each type of hardware requested by the architect. Samples shall be of the same finish, style, and function as specified herein. Tag each sample with its permanent location so that it may be used in the final work.
- J. Furnish with first submittal, a list of required lead times for all hardware items.
- K. After final approved schedule is returned, transmit corrected copies for distribution and field use in quantities as required by Division 01 - General Requirements.
- L. Furnish approved hardware schedules, template lists, and pertinent templates as requested by related trades.
- M. Furnish necessary diagrams, schematics, voltage and amperage requirements for all electro-mechanical devices or systems as required by related trades. Wiring diagrams shall be opening specific and include both a riser diagram and point to point diagram showing all wiring terminations.
- N. After receipt of approved hardware schedule, Hardware supplier shall initiate a meeting including the owner's representative to determine keying requirements. Upon completion of initial key

meeting, hardware supplier shall prepare a proposed key schedule with symbols and abbreviations as set forth in the door and hardware institute's publication "Keying Procedures, Systems, and Nomenclature". Submit copies of owner approved key schedule for review and field use in quantities as required by Division 01 - General Requirements. Wiring diagrams shall be included in final submittals transmitted for distribution of field use.

1.6 QUALITY ASSURANCE

- A. Manufacturers and model numbers listed are to establish a standard of function and quality. Similar items by approved manufacturers that are equal in design, function, and quality, may be considered for prior approval of the architect, provided the required data and physical samples are submitted for approval as set forth in Division 01 - General Requirements.
- B. Where indicated in this specification, products shall be independently certified by ANSI for compliance with relevant ANSI/BHMA standards A156.1 - A156.36 – Standards for Hardware and Specialties. All products shall meet or exceed certification requirements for the respective grade indicated within this specification. Supplier shall provide evidence of certification when requested by the architect.
- C. Obtain each type of hardware (hinges, latch & locksets, exit devices, closers, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements.
- D. Electrical drawings and electrical specifications are based on the specific electrified hardware components specified in hardware sets. When electronic hardware components other than those indicated in hardware sets are provided, the supplier shall be responsible for all costs incurred by the design team and their consultants to review and revise electrical drawings and electrical specifications. Supplier shall also be responsible for any additional costs associated with required changes in related equipment, materials, installation, or final hook up to ensure the system will operate and function as indicated in the construction documents, including hardware set operational / functional descriptions.
- E. All hardware items shall be manufactured no earlier than 6 months prior to delivery to site.
- F. Hardware supplier shall be factory trained and certified by the manufacture to provide and support all computer managed locks and system components.
- G. Installation of hardware shall be installed or directly supervised and inspected by a skilled installer certified by the manufacturer of locksets, door closers, and exit devices used on the project, or with not less than 3 years' experience in successful completion of projects similar in size and scope.
- H. Provide hardware for all labeled fire doors, which complies with positive pressure fire testing UL 10C.
- I. Comply with all applicable provisions of the standards referenced within section 1.4 of this specification.
- J. Hardware supplier shall participate when reasonably requested to meet with the contractor and or architect to inspect any claim for incorrect or non-functioning materials; following such inspection, the hardware supplier shall provide a written statement documenting the cause and proposed remedy of any unresolved items.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Hardware supplier shall deliver hardware to the job site unless otherwise specified.
- B. All hardware shall be delivered in manufacturers' original cartons and shall be clearly marked with set and door number.
- C. Coordinate with contractor prior to hardware delivery and recommend secure storage and protection against loss and damage at job site.

- D. Contractor shall receive all hardware and provide secure and proper protection of all hardware items to avoid delays caused by lost or damaged hardware. Contractor shall report shortages to the Architect and hardware supplier immediately after receipt of material at the job site.
- E. Coordinate with related trades under the direction of the contractor for delivery of hardware items necessary for factory installation.

1.8 PRE-INSTALLATION MEETING

- A. Schedule a hardware pre-installation meeting on site to review and discuss required door operating clearances and the installation of continuous hinges, locksets, door closers, exit devices, overhead stops, and electromechanical door hardware.
- B. Meeting attendees shall be notified 7 days in advance and shall include: Architect, Contractor, Door Hardware Installers (including low voltage hardware), Manufacturers representatives for above hardware items, and any other effected subcontractors or suppliers.
- C. All attendees shall be prepared to distribute installation manuals, hardware schedules, templates, and physical hardware samples.

1.9 WARRANTY

- A. All hardware items shall be warranted against defects in material and workmanship as set forth in Division 01 - General Requirements.
- B. Repair, replace, or otherwise correct deficient materials and workmanship without additional cost to owner.

PART 2 - PRODUCTS

2.1 FASTENERS

- A. All exposed fasteners shall be Phillips head or as otherwise specified and shall match the finish of the adjacent hardware. All fasteners ex-posed to the weather shall be non-ferrous or stainless steel. Furnish correct fasteners to accommodate surrounding conditions.
- B. Coordinate required reinforcements for doors and frames. Seek approval of the architect prior to furnishing through-bolts. Furnish through-bolts as required for materials not readily reinforced.

2.2 BUTT HINGES

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Ives</u>	<u>Stanley</u>	<u>Hager</u>	<u>McKinney</u>
1. Standard Weight, Plain Bearing	5PB1	F179	****	T2714
2. Standard Weight, Ball Bearing	5BB1	BB179	BB1279	TB2714
3. Standard Weight, Ball Bearing, Non-Ferrous	5BB1	FBB191	BB1191	TB2314
4. Heavy Weight, Ball Bearing	5BB1HW	FBB168	BB1168	T4B3786
5. Heavy Weight, Ball Bearing, Non-Ferrous	5BB1HW	FBB199	BB1199	T4B3386

- B. Hinges shall be independently certified by ANSI for compliance with ANSI A156.1 (2006). Hinges shall meet or exceed the following ANSI grade requirements as indicated below:
 - 1. Standard Weight, Plain Bearing Hinges: Grade 3
 - 2. Standard Weight, 2 Ball Bearing Hinges: Grade 2
 - 3. Heavy Weight, 4 Ball Bearing Hinges: Grade 1
- C. Unless otherwise specified, furnish the following hinge quantities for each door leaf.
 - 1. 3 hinges for doors up to 90 inches.
 - 2. 1 additional hinge for every 30 inches on doors over 90 inches.
 - 3. 4 hinges for Dutch door applications.
- D. Unless otherwise specified, top and bottom hinges shall be located as specified in Division 08 Section "Hollow Metal Doors and Frames". Intermediate hinges shall be located equidistant from others.

- E. Unless otherwise specified, furnish hinge weight and type as follows:
 1. Standard weight: plain bearing hinge 5PB1 or ball bearing hinge 5BB1 for interior openings through 36 inches wide without a door closer.
 2. Standard weight: ball bearing hinge 5BB1 for interior opening over 36 through 40 inches wide without a door closer, and for interior openings through 40 inches wide with a door closer.
 3. Heavyweight: 4 ball bearing hinge 5BB1HW for interior openings over 40 inches wide, and for all vestibule doors.
 4. Heavyweight: 4 ball bearing hinge 5BB1HWss for exterior openings unless otherwise listed in groups.
 5. Heavyweight: 4 ball bearing hinge 5BB1HWss 5" for all exterior doors or 4 ball bearing hinge 5BB1HW 5" for interior doors, that have an automatic operator.
- F. At existing frames receiving new hinges, match existing hinge size and weight.
- G. Unless otherwise specified, furnish brass, bronze, or stainless-steel base metal for hinges at exterior doors. Unless otherwise specified, furnish steel base metal for hinges at interior doors.
- H. Furnish stainless steel base metal for hinges at showers, pools, and wash bay doors.
- I. Unless otherwise specified, furnish hinges in the following sizes:
 1. 5" x 5" 2-1/4" thick doors
 2. 4-1/2" x 4-1/2" 1-3/4" thick doors
 3. 3-1/2" x 3-1/2" 1-3/8" thick doors
- J. Furnish hinges with width to accommodate trim and allow for 180-degree swing.
- K. Unless otherwise specified, furnish hinges with flat button tips with non-rising pins at interior doors, non-removable loose pins (NRP) at exterior, and out-swinging lockable interior doors.
- L. Unless otherwise specified, furnish all hinges to template standards.

2.3 CONTINUOUS PIN AND BARREL HINGES

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Ives</u>	<u>Markar</u>	<u>Stanley</u>
1. Edge Mount Pin & Barrel Stainless Steel Continuous Hinge	700 Series	300 Series	650 Series
- B. Hinges shall be independently certified by ANSI for compliance with ANSI A156.26, Grade 1 (2012).
- C. Continuous hinges shall be full height pin and barrel type hinge providing full height door support up to 600 lbs. Edge mount (unless noted otherwise).
- D. Construct hinges of heavy-duty 14-gauge material. The stainless internal pin shall have a diameter of 0.25 and the exterior barrel diameter of 0.438.
- E. Hinge shall be non-handed with symmetrical template hole pattern and factory drilled. Hinge must accept a minimum of 21 fasteners on the door and 21 fasteners on the frame.
- F. Each knuckle to be 2 inches, including split nylon bearing at each separation for quiet, smooth, self-lubricating operation.
- G. Hinge to be able to carry Warnock Hersey Int. or UL for fire rated doors and frames up to 3 hours.
- H. Provide machine screws for doors which have been reinforced to accept machine screws.
- I. Note: Fire label for doors and frames should be placed on the header and top rail of fire rated doors and frames.
- J. Provide adjusting screws equal to Ives "Adjust-a-Stud" for continuous hinges specified as 705. Adjustment to be able to correct frame fit problems up to 3/8 inch.

2.4 POWER TRANSFERS

- A. Acceptable manufacturers and respective catalog numbers:
- | | <u>Von Duprin</u> | <u>ASSA</u> |
|-----------------------|-------------------|-------------|
| 1. Concealed Two Wire | EPT-2 | CEPT-10 |
| 2. Concealed Ten Wire | EPT-10 | CEPT-10 |
- B. Door cords shall be armored cable with screw on caps.
- C. Concealed power transfers shall be concealed in the door and frame when the door is closed.
- D. Concealed power transfers shall have a steel tube to protect wires from being cut.
- E. Concealed power transfers with spring tubes shall be rejected.
- F. Concealed power transfers shall be supplied with a mud box to house all terminations.

2.5 FLUSH BOLTS AND DUST PROOF STRIKES

- A. Acceptable manufacturers and respective catalog numbers:
- | | <u>Ives</u> | <u>Trimco</u> | <u>Hager</u> |
|--|-------------|---------------|--------------|
| 1. Dust Proof Strike | DP2 | 3910 | 280X |
| 2. Constant Latching Bolt (Metal Door) | FB51P | 3820 | 293D |
| 3. Constant Latching Bolt (Wood Door) | FB61P | 3825L | 294D |
| 4. Manual Flush Bolt | FB458 | 3915 | 282D |
- B. Unless otherwise specified, provide 12" rods for manual flush bolts for door 7'6" or less, 24" top rods for doors over 7'6" to 8'6".
- C. Unless otherwise specified, provide doors over 8'6" with automatic top bolts.
- D. Provide automatic flush bolts where required to maintain fire door listing and or egress requirements on pairs of doors.
- E. All flush-bolt applications shall be UL listed to be installed with top flush-bolt only. Provide auxiliary fire bolt as required for fire rated openings where less bottom bolt has been specified.
- F. Provide all bottom flush bolts with non-locking dust proof strikes.

2.6 EXIT DEVICES

- A. Acceptable manufacturers and respective catalog numbers:
- | | <u>Von Duprin</u> | <u>Detex</u> |
|--|-------------------|---------------------------|
| 1. Wide Stile, Push Pad | 99 Series | Advantex (Wide Stile) |
| 2. Wide Stile, Electric Latch Retraction | QEL 99 Series | Advante-ER x (Wide Stile) |
- A. Exit devices shall be independently certified by ANSI for compliance with ANSI A156.3, Grade 1 (2008).
- B. Obtain exit devices from a single manufacturer, although several may be indicated as offering products complying with requirements.
- C. All exit devices shall be equipped with a sound-dampening feature to reduce touch pad return noise.
- D. Quiet Electric Latch Retraction shall be accomplished using a motor driven assembly, and shall incorporate the following features:
1. Motor shall retract both the push pad assembly and latchbolt.
 2. Automatic calibration of latch throw and pull.
 3. Built-in time delay.
 4. On-board installation and troubleshooting diagnostics built into power supply and device.
 5. Retry mode if device does not pull on the first try.
- E. On full glass doors there shall be no exposed fasteners on the back of the mechanism visible through the glass.

- F. All exit devices shall be provided with flush end caps to reduce potential damage from impact.
- G. All exit devices shall be provided with dead-locking latch bolts to ensure security.
- H. All exit devices shall be U.L. listed for accident hazard. Exit device for use on fire doors shall also be U.L. listed for fire exit hardware.
- I. Provide optional strikes, special length rods, and adapter plates to accommodate door and frame conditions. Provide narrow style series devices in lieu of wide stile series devices where optional strikes will not accommodate door and frame conditions.
- J. Coordinate with related trades to ensure adequate clearance and reinforcement is provided in doors and frames. Provide thru bolts as required.
- K. Refer to hardware groups for exit device applications utilizing the option of: "less bottom rod and floor strike" (LBR)
- L. All exit devices shall be provided with optional trim designs to match other lever and pull designs used on the project.
- M. Unless specific exit device dogging options are noted within hardware sets, provide dogging options as follows:
 - 1. Fire Rated devices: Dogging not permitted.
 - 2. Non-Rated Exit Only functions not equipped with outside trim or pull: Less Dogging.
 - 3. Non-Rated Classroom functions: Less Dogging.
 - 4. Non-Rated devices utilizing electric latch retraction or electrified outside trim: Less Dogging.
 - 5. All Other Non-Rated devices: Cylinder Dogging utilizing interchangeable core cylinders. Cylinder keyway shall match locksets furnished on this project.
- N. Provide glass bead kits as required to accommodate door conditions. Screws shall not be visible through full glass doors.
- O. Where specified, provide compatible keyed mullions with cylinder for pairs of doors.
- P. Provide Von Duprin #154 or equivalent mullion/frame stabilizers at the following application(s):
 - 1. Lockable exterior or vestibule paired openings with a fixed or removable hollow metal or aluminum mullion.
 - 2. Lockable exterior or vestibule single doors in aluminum frames.
- Q. Provide reinforced crossbars for all traditional style exit devices applied to doors over 36" wide.

2.7 LOCKS AND LATCHES

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Falcon</u>	<u>No Substitution</u>
1. Grade 1 Mortise	MA Series SG	
- B. Bored locks shall be independently certified by ANSI for compliance with ANSI A156.2 (2011). Interconnected locks shall be independently certified by ANSI for compliance with ANSI A156.12 (2013). Mortise locks shall be independently certified by ANSI for compliance with ANSI A156.13 (2012).
- C. Unless otherwise specified, all locks and latches to have:
 - 1. 2-3/4" Backset
 - 2. 1/2" minimum throw latchbolt
 - 3. 1" throw deadbolt
 - 4. ANSI A115.2 strikes
- D. Provide guarded latch bolts for all locksets, and latch bolts with throw to maintain fire rating of both single and paired door assemblies.
- E. Provide strike with lip length adequate to clear surrounding trim.

- F. Provide wrought boxes for strikes at inactive doors, wood frames, and metal frames without integral mortar covers.
- G. Provide Von Duprin #154 or equivalent mullion/frame stabilizers at the following application(s) unless provided with deadbolt:
 - 1. Lockable exterior or vestibule paired openings with a fixed or removable hollow metal or aluminum mullion.
 - 2. Lockable exterior or vestibule single doors in aluminum frames.

2.8 PULLS, PUSH BARS, PUSH/PULL PLATES

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Ives</u>	<u>Burns</u>	<u>Hager</u>
1. Offset Door Pull (1" dia., 10" CTC)	8190-0	39C	12J
2. Offset Pull / Push-Bar (1" dia., 10" CTC Pull)	9190-0	422 x 39C	159

- A. Adjust dimensions of push plates to accommodate stile and rail dimensions, lite and louver cutouts, and adjacent hardware. Where required by adjacent hardware, push plates shall be factory drilled for cylinders or other mortised hardware. All push plates shall be beveled 4 sides and counter sunk.
- B. Where required on wide stile doors, install straight pull offset of cylinder to allow for access to cylinder.
- C. Where possible, provide back-to-back, and concealed mounting for pulls and push bars. Push bar length shall be 3" less door width, or center of stile to center of stile for stile & rail or full glass doors.

2.9 CLOSERS

- A. Acceptable manufacturers and respective catalog numbers:

<u>LCN</u>	<u>Sargent</u>
1. 4040XP / 4040XP EDA	281 / 281P10

- B. Door closers shall be independently certified by ANSI for compliance with ANSI A156.4, Grade 1 (2013).
- C. Obtain door closers from a single manufacturer, although several may be indicated as offering products complying with requirements.
- D. Provide extra heavy-duty arm (EDA / HD) when closer is to be installed using parallel arm mounting.
- E. Hardware supplier shall coordinate with related trades to ensure aluminum frame profiles will accommodate specified door closers.
- F. Closers shall use high strength cast iron cylinders, forged main arms, and one-piece forged steel pistons.
- G. Closers shall utilize a stable fluid withstanding temperature range of +120deg F to -30deg F without seasonal adjustment of closer speed to properly close the door. Closers for fire-rated doors shall be provided with temperature stabilizing fluid that complies with standards UL10C.
- H. Unless otherwise specified, all door closers shall have full covers and separate adjusting valves for sweeps, latch, and backcheck.
- I. Provide closers for all labeled doors. Provide closer series and type consistent with other closers for similar doors specified elsewhere on the project.
- J. Provide closers with adjustable spring power. Size closers to ensure exterior and fire rated doors will consistently close and latch doors under existing conditions. Size all other door closers to allow for reduced opening force not to exceed 5 lbs.

- K. Install closers on the room side of corridor doors, stair side of stairways and interior side of exterior doors.
- L. Closers shall be furnished complete with all mounting brackets and cover plates as required by door and frame conditions, and by adjacent hardware.
- M. Door closers shall be provided with a powder coat finish to provide superior protection against the effects of weathering. Powder coat finish shall successfully pass a 100 hour salt spray test.

2.10 LOW ENERGY ELECTRO-HYDRAULIC AUTOMATIC OPERATORS

- A. Acceptable manufacturers and respective catalog numbers:
 - 1. Electro-Hydraulic Operator

<u>LCN</u>
4640
- B. Low energy operators shall be independently certified by ANSI for compliance with ANSI A156.19 (2002).
- C. Where low kinetic energy, as defined by ANSI/BHMA Standard A156.19, power operators are indicated for doors required to be accessible to the disabled, provide electrically powered operators complying with the ADA for opening force and time to close standards.
- D. The closing action shall be controlled by modern type cast iron door closer cylinder filled with a flat viscosity fluid, stable from +120F to -30F that would require no seasonal adjustments. The closer shall have field adjustable spring power; have two independent closing speed adjustment valves, and hydraulic back-check.
- E. Full closing force shall be provided when the power or assist cycle ends.
- F. All power operator systems shall include the following features and functions:
 - 1. Provisions for separate conduits to carry high and low voltage wiring in compliance with the National Electrical Code, section 725-31.
 - 2. The operator will be designed with an electronically controlled mechanical clutching mechanism to prevent damage to the operator if the system is actuated while the door is latched or if the door is forced closed during the opening cycle.
 - 3. All covers, mounting plates and arm systems shall be powder coated and successfully pass a minimum of 100 hours testing as outlined in ANSI/BHMA Standard A156.18.
 - 4. UL listed for use on labeled doors.
 - 5. All operators shall be non-handed with spring power over a range of at least four sizes; either 1 through 4 or 2 through 5.
 - 6. The power operator shall incorporate microprocessor controlled digital controls including factory default memory settings, on-board diagnostics, non-volatile memory, and integrated delay and relay for controlling door release devices.
 - 7. Provisions in the control box or module shall provide control (inputs and outputs) for; electric strike delay, auxiliary contacts, sequential operation, fire alarms systems, actuators, swing side sensors, and stop side sensors.
 - 8. Exterior switches shall be weather resistant and mount on a single gang electrical box furnished by Division 26.
- G. All electrically powered operators shall include the following features or functions:
 - 1. When an obstruction or resistance to the opening swing is encountered, the operator will pause at that point, then attempt to continue opening the door. If the obstruction or resistance remains, the operator will again pause the door.
 - 2. Easily accessible main power and maintain hold open switches will be provided on the operator.
 - 3. An electronically controlled clutch to provide adjustable opening force.
 - 4. A microprocessor to control all motor and clutch functions.
 - 5. An on-board power supply capable of delivering both 12V and 24V outputs up to a maximum of 1.0 ampere combined load.

- 6. All input and output power wiring shall be protected by slow blow fuses. These fuses shall be easily replaceable without special tools or component replacement.
- 7. If electrical failure occurs, the unit shall operate as a standard door closer.
- H. Power Operators shall be warranted by the manufacture to be free from defects in material and workmanship for a period of two years.

2.11 KICK PLATES AND MOP PLATES

- A. Furnish protective plates as specified in hardware groups.
- B. Where specified, provide 10" kick plates, 34" armor plates, and 4" mop plates. Unless otherwise specified, metal protective plates shall be .050" thick; plastic plates shall be 1/8" thick.
- C. Protective plates shall be 2" less door width, or 1" less door width at pairs. All protective plates shall be beveled 4 sides and counter sunk.
- D. Protection plates over 16" shall not be provided for labeled doors unless specifically approved by door manufacturers listing. When protection plates over 16" are provided for labeled doors, the plate shall be labeled.
- E. Where specified, provide surface mounted door edges. Edges shall butt to protective plates. Provide edges with cutouts as required adjacent hardware.
- F. Adjust dimensions of protection plates to accommodate stile and rail dimensions, lite and louver cutouts, and adjacent hardware. Where required by adjacent hardware, protection plates shall be factory drilled for cylinders or other mortised hardware.

2.12 OVERHEAD STOPS

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Glynn-Johnson</u>	<u>Rixson</u>	<u>Sargent</u>
1. Heavy Duty Surface Mount	GJ900 Series	9 Series	590
2. Heavy Duty Concealed Mount	GJ100 Series	1 Series	690
- B. Unless otherwise specified, furnish GJ900 series overhead stop for hollow metal or 1-3/4" solid core doors equipped with regular arm surface type closers that swing more than 140 degrees before striking a wall, for hollow metal or 1-3/4" solid core doors that open against equipment, casework, sidelights, or other objects that would make wall bumpers inappropriate, and as specified in hardware groups.
- C. Furnish sex bolt attachments for wood and mineral core doors unless doors are supplied with proper reinforcing blocks.
- D. Provide special stop only ("SE" suffix) overhead stops when used in conjunction with electronic hold open closers.
- E. Do not provide holder function for labeled doors.

2.13 WALL STOPS AND HOLDERS

- A. Acceptable manufacturers and respective catalog numbers:

	<u>Ives</u>	<u>Hager</u>	<u>Burns</u>
1. Wrought Convex Wall Stop	WS406CVX	232W	570
2. Wrought Concave Wall Stop	WS406CCV	236W	575
3. Automatic Wall Holder	WS40	326W	533
- B. Furnish a stop or holder for all doors.
- C. Provide concave style wall stop at all adjacent integral push button locks; provide convex style wall stop at all other locations.
- D. Where wall stops are not applicable, furnish overhead stops.
- E. Furnish floor stops or hinge pin stops only where specified in hardware sets.

F. Do not provide holder function for labeled doors.

2.14 MAGNETIC HOLD OPENS

A. Acceptable manufacturers and respective catalog numbers:

	<u>LCN</u>	<u>ABH</u>	<u>Edwards</u>
1. Wall Holder	SEM 7800	2000	1500

B. Magnetic hold opens shall be independently certified by ANSI for compliance with ANSI A156.15, Grade 1 (2006).

C. Magnetic holder's housing and armature shall be constructed of a die cast zinc material.

D. Provide types as listed in groups.

E. Where wall conditions do not permit the armature to reach the magnet, provide extensions.

F. Provide proper voltage and power consumption as required by Division 16.

G. Coordinate electrical requirements and mounting locations with other trades.

2.15 WEATHERSTRIP, GASKETING

A. Acceptable manufacturers and respective catalog numbers:

	<u>Zero</u>	<u>Pemko</u>	<u>NGP</u>	<u>Reese</u>
1. Weatherstrip	429	2891_PK	700NA	755
2. Adhesive Gasket	188	S88	5050	797
3. Mullion Seal/Silencer	8780	5110	5100N	628
4. Sweep w/ drip	8198	345_N	C627	354
5. Drip Cap	142	346	16	R201

B. Weatherstrip and gasketing shall be independently certified by ANSI for compliance with ANSI A156.22 (2005).

C. Where specified in the hardware groups, furnish the above products unless otherwise detailed in groups.

D. Provide weatherstripping all exterior doors and where specified.

E. Provide intumescent and other required edge sealing systems as required by individual fire door listings to comply with positive pressure standards UL 10C.

F. Provide Zero 188 smoke gaskets at all fire rated doors and smoke and draft control assemblies.

G. Provide gasketing for all meeting edges on pairs of fire doors. Gasketing shall be compatible with astragal design provided by door supplier as required for specific fire door listings.

2.16 THRESHOLDS

A. Acceptable manufacturers and respective catalog numbers:

	<u>Zero</u>	<u>Pemko</u>	<u>NGP</u>	<u>Reese</u>
1. Saddle Thresholds	8655	171	425	S205
2. Half Saddle Thresholds	1674	227	324	S239
3. Interlocking Threshold	74A	114	442-5	T550

A. Thresholds shall be independently certified by ANSI for compliance with ANSI A156.21 (2001).

B. Hardware supplier shall verify all finish floor conditions and coordinate proper threshold as required to ensure a smooth transition between threshold and interior floor finish.

C. Threshold Types:

1. Unless otherwise specified, provide saddle threshold similar to Zero 8655 for all exterior openings with an interior floor finish less than or equal to 1/4" in height.
2. Unless otherwise specified, provide half saddle threshold similar to Zero 1674 for all exterior openings with an interior floor finish greater than 1/4" in height. Threshold height shall match thickness of interior floor finish.

2.17 ELECTRIC STRIKES

- A. Acceptable manufacturers and respective catalog numbers:
 - 1. Type 1 Von Duprin HES
 6200 Series 4500C Series
- B. Provide electric strikes compatible with the type of locks shown at each opening where specified.
- C. Electric strikes shall be UL listed as Burglary-Resistant Electric Door Strikes and where required shall be UL listed as Electric Strike for Fire Doors.
- D. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.18 DOOR POSITION SWITCHES

- A. Acceptable manufacturers and respective catalog numbers:
 - 1. Concealed Schlage Electronics GRI Sargent
 679 Series 190-12 3287

2.19 FINISHES AND BASE MATERIALS (ALUMINUM DOORS/FRAMES)

- A. Unless otherwise indicated in the hardware groups or herein, hardware finishes shall be applied over base metals as specified in the following finish schedule:

<u>HARDWARE ITEM</u>	<u>BHMA FINISH AND BASE MATERIAL</u>
1. Continuous Hinges	313AN (Anodized Duranodic)
2. Exit Devices	613 (US10B - Oil Rubbed Bronze)
3. Pulls and Push Plates/Bars	613 (US10B - Oil Rubbed Bronze)
4. Closers	695 (Powder Coat Dark Bronze)
5. Overhead Stops	613 (US10B - Oil Rubbed Bronze)
6. Thresholds	719 (Mill Aluminum)
7. Weather-strip, Sweeps Drip Caps	Dark Bronze Anodized
8. Magnetic Holders	695 (Powder Coat Dark Bronze)
9. Miscellaneous	613 (US10B - Oil Rubbed Bronze)

2.20 FINISHES AND BASE MATERIALS (WOOD/HOLLOW METAL DOORS/FRAMES)

- A. Unless otherwise indicated in the hardware groups or herein, hardware finishes shall be applied over base metals as specified in the following finish schedule:

<u>HARDWARE ITEM</u>	<u>BHMA FINISH AND BASE MATERIAL</u>
1. Butt Hinges: Exterior, or Non-Ferrous	630 (US32D - Satin Stainless Steel)
2. Butt Hinges: Interior	652 (US26D - Satin Chromium)
3. Flush Bolts	626 (US26D - Satin Chromium)
4. Exit Devices	626 (US26D - Satin Chromium)
5. Locks and Latches	626 (US26D - Satin Chromium)
6. Pulls and Push Plates/Bars	630 (US32D - Satin Stainless Steel)
7. Coordinators	600 (Prime painted or mill alum.)
8. Closers	689 (Powder Coat Aluminum)
9. Protective Plates	630 (US32D - Satin Stainless Steel)
10. Overhead Stops	630 (US32D - Satin Stainless Steel)
11. Wall Stops and Holders	630 (US32D - Satin Stainless Steel)
12. Thresholds	719 (Mill Aluminum)
13. Weather-strip, Sweeps Drip Caps	Aluminum Anodized
14. Magnetic Holders	689 (Powder Coat Aluminum)
15. Miscellaneous	626 (US26D - Satin Chromium)

2.21 KEYING

- A. Provide all cylinders in keyways as required to accommodate owners existing Yale key system.
- B. All locks under this section shall be keyed as directed by the owner to an existing Master Key System.

- C. Furnish a total of 2 keys per cylinder. Actual cut keys to be determined by owner.
- D. Master keys, control keys, and change keys shall be delivered by registered mail to the owner. Construction keys shall be delivered to the contractor.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to installation of hardware, installer shall examine door frame installation to ensure frames have been set square and plumb. Installer shall examine doors, door frames, and adjacent wall, floor, and ceiling for conditions, which would adversely affect proper operation and function of door assemblies. Do not proceed with hardware installation until such deficiencies have been corrected.

3.2 INSTALLATION

- A. Before hardware installation, general contractor/construction manager shall coordinate a hardware installation seminar with a 1 week notice to all parties involved. The seminar is to be conducted on the installation of hardware, specifically of locksets, closers, exit devices, continuous hinges and overhead stops. Manufacturer's representative of the above products to present seminar. Seminar to be held at the job site and attended by installers of hardware (including low voltage hardware) for aluminum, hollow metal and wood doors. Training to include use of installation manuals, hardware schedule, templates and physical products samples.
- B. Shim doors as required to maintain proper operating clearance between door and frame.
- C. Install all hardware in accordance with the approved hardware schedule and manufacturer's instructions for installation and adjustment.
- D. Set units level, plumb and true to the line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- E. Provide blocking or reinforcement for all hardware mounted to drywall construction, including wall mounted door stops and holders.
- F. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accord with industry standards.
- G. Drill appropriate size pilot holes for all hardware attached to wood doors and frames.
- H. Unless otherwise specified, locate all hardware in accordance with the recommended locations for builders hardware for standard doors and frames as published by the Door and Hardware Institute (TDH-007-20).
- I. Use only fasteners supplied by or approved by the manufacturer for each respective item of hardware.
- J. Mortise and cut to close tolerance and conceal evidence of cutting in the finished work.
- K. Conceal push and pull bar fasteners where possible. Do not install through bolts through push plates.
- L. Install hardware on UL labeled openings in accordance with manufacturer's requirements to maintain the label.
- M. Apply self-adhesive gasketing on frame stop at head & latch side and on rabbet of frame at hinge side.
- N. Install hardware in accordance with supplemental "S" label instructions on all fire rated openings.
- O. Install wall stops to contact lever handles or pulls. Do not mount wall stops on casework, or equipment.

- P. Where necessary, adjust doors and hardware as required to eliminate binding between strike and latchbolt. Doors should not rattle.
- Q. Overhead stops used in conjunction with electrified hold open closers shall be templated and installed to coincide with engagement of closer hold open position.
- R. Install door closers on corridor side of lobby doors, room side of corridor doors, and stair side of stairways.
- S. Adjust spring power of door closers to the minimum force required to ensure exterior and fire rated doors will consistently close and latch doors under existing conditions. Adjust all other door closers to ensure opening force does not to exceed 5 lbs.
- T. Adjust "sweep", "latch", & "back check" valves on all door closers to properly control door throughout the opening and closing cycle. Adjust total closing speed as required to comply with all applicable state and local building codes.
- U. Install "hardware compatible" (bar stock) type weatherstripping continuously for an uninterrupted seal. Adjust templating for parallel arm door closers, exit devices, etc., as required to accommodate weatherstripping.
- V. Unless otherwise specified or detailed, install thresholds with the bevel in vertical alignment with the outside door face. Notch and closely fit thresholds to frame profile. Set thresholds in full bed of sealant.
- W. Compress sweep during installation as recommended by sweep manufacturer to facilitate a water-resistant seal.
- X. Deliver to the owner 1 complete set of installation and adjustment instructions, and tools as furnished with the hardware.

3.3 FIELD QUALITY CONTROL

- A. After installation has been completed, the hardware supplier and manufacturers representative for locksets, door closers, exit devices, and overhead stops shall check the project and verify compliance with installation instructions, adjustment of all hardware items, and proper application according to the approved hardware schedule. Hardware representative shall submit a list of all hardware that has not been installed correctly.
- B. After installation has been completed, the hardware supplier and manufacturers representative shall meet with the owner to explain the functions, uses, adjustment, and maintenance of each item of hardware. Hardware supplier shall provide the owner with a copy of all wiring diagrams. Wiring diagrams shall be opening specific and include both a riser diagram and point to point diagram showing all wiring terminations.

3.4 ADJUSTMENT AND CLEANING

- A. At final completion, and when H.V.A.C. equipment is in operation, installer shall make final adjustments to and verify proper operation of all door closers and other items of hardware. Lubricate moving parts with type lubrication recommended by the manufacturer.
- B. All hardware shall be left clean and in good operation. Hardware found to be disfigured, defective, or inoperative shall be repaired or replaced.

3.5 EXTRA STOCK

- A. See hardware sets for additional hardware. Additional hardware is to be delivered directly to the owner for maintenance purposes.
- B. Extra screws shall be furnished to the contractor for installation purposes. See hardware sets for a detailed listing of extra screws.
- C. All extra hardware items, fasteners, and special installation tools are to be turned over to the owner at completion of the project.

3.6 HARDWARE SCHEDULE

- A. The following schedule of hardware groups are intended to describe opening function. The hardware supplier is cautioned to refer to the preamble of this specification for a complete description of all materials and services to be furnished under this section.

OPT0413455 Version 1

HW SET 01

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	CLASSROOM LOCK	MA561	FAL
1	EA	WALL STOP	WS406/407CCV	IVE

FUNCTION: MA561 CLASSROOM LOCK (F05)
DEADLOCKING LATCH BOLT BY KNOBS/LEVERS. OUTSIDE KNOB/LEVER LOCKED BY KEY
OUTSIDE. INSIDE KNOB/LEVER ALWAYS FREE.

HW SET 02

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	STOREROOM LOCK	MA581	FAL
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE

FUNCTION: MA581 STOREROOM LOCK/EXIT LOCK (F07)
DEADLOCKING LATCH BOLT BY INSIDE KNOB/LEVER OR KEY OUTSIDE. OUTSIDE KNOB/LEVER
RIGID.

HW SET 03

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	MANUAL FLUSH BOLT	FB458	IVE
			(BOTTOM BOLT)	
1	EA	CONST LATCHING BOLT	FB51T / FB61T	IVE
			(TOP BOLT)	
1	EA	DUST PROOF STRIKE	DP2	IVE
1	EA	STOREROOM LOCK	MA581	FAL
1	EA	OH STOP	90S	GLY
1	EA	SURFACE CLOSER	4040XP H	LCN
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	OVERLAP ASTRAGAL	(BY DOOR SUPPLIER)	

FUNCTION: MA581 STOREROOM LOCK/EXIT LOCK (F07)
DEADLOCKING LATCH BOLT BY INSIDE KNOB/LEVER OR KEY OUTSIDE. OUTSIDE KNOB/LEVER
RIGID.

HW SET 04

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	MANUAL FLUSH BOLT	FB458	IVE
1	EA	CONST LATCHING BOLT	(BOTTOM BOLT) FB51T / FB61T	IVE
1	EA	DUST PROOF STRIKE	(TOP BOLT) DP2	IVE
1	EA	STOREROOM LOCK	MA581	FAL
1	EA	OH STOP	90S	GLY
1	EA	SURFACE CLOSER	4040XP / 4040XP EDA	LCN
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	OVERLAP ASTRAGAL	(BY DOOR SUPPLIER)	

FUNCTION: MA581 STOREROOM LOCK/EXIT LOCK (F07)

DEADLOCKING LATCH BOLT BY INSIDE KNOB/LEVER OR KEY OUTSIDE. OUTSIDE KNOB/LEVER RIGID.

HW SET 05

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	STOREROOM LOCK	MA581	FAL
1	EA	ELECTRIC STRIKE	6211 FSE	VON
1	EA	SURFACE CLOSER	4040XP / 4040XP EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	FIRE/LIFE WALL MAGNET	SEM 7800	LCN
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER
1	EA	ACCESS CONTROL	(BY DIVISION 28)	
1	EA	DOOR CONTACT	679 SERIES	SCE
1	EA	POWER SUPPLY	(BY DIVISION 28)	SCE
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	
1	EA	N/C F/A CONTACT	(BY F/A CONTRACTOR)	

FUNCTION: MA581 STOREROOM LOCK/EXIT LOCK (F07)

DEADLOCKING LATCH BOLT BY INSIDE KNOB/LEVER OR KEY OUTSIDE. OUTSIDE KNOB/LEVER RIGID.

A VALID CREDENTIAL RELEASES ELECTRIC STRIKE.

HW SET 06

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	STOREROOM LOCK	MA581	FAL
1	EA	ELECTRIC STRIKE	6211 FSE	VON
1	EA	SURFACE CLOSER	4040XP / 4040XP EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	WALL STOP	WS406/407CCV	IVE
1	EA	SMOKE SEALS	188S (AT RATED OR SMOKE & DRAFT CONTROL DRS ONLY)	ZER
1	EA	ACCESS CONTROL	(BY DIVISION 28)	
1	EA	DOOR CONTACT	679 SERIES	SCE
1	EA	POWER SUPPLY	(BY DIVISION 28)	SCE
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	

FUNCTION: MA581 STOREROOM LOCK/EXIT LOCK (F07)
DEADLOCKING LATCH BOLT BY INSIDE KNOB/LEVER OR KEY OUTSIDE. OUTSIDE KNOB/LEVER RIGID.
A VALID CREDENTIAL RELEASES ELECTRIC STRIKE.

HW SET 07

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	KEYED REMOVABLE MULLION	KR-4954 STAB	VON
1	EA	PANIC HARDWARE	LD-99-EO	VON
1	EA	PANIC HARDWARE	LD-99-NL	VON
2	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
2	EA	SURFACE CLOSER	4040XP SCUSH	LCN
2	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	RAIN DRIP	142	ZER
1	SET	WEATHERSTIP	429	ZER
1	EA	MULLION SEAL	8780	ZER
2	EA	DOOR SWEEP	8198	ZER
1	EA	THRESHOLD	(PROFILE AS REQUIRED)	ZER
2	EA	DOOR CONTACT	679 SERIES	SCE

FUNCTION: (NL) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED.

HW SET 08

2	EA	CONTINUOUS HINGE	700	IVE
2	EA	PUSH/PULL BAR	9190-10"	IVE
2	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4040XP EDA	LCN
1	EA	SURF. AUTO OPERATOR	4642	LCN
2	EA	ACTUATOR, TOUCH	8310-853 / 8310-818	LCN

FUNCTION: PUSH/PULL.
THIS DOOR HAS A POWER OPERATOR. BOTH ACTUATORS ALWAYS ACTIVE TO OPEN THE DOOR.

HW SET 09

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	ELEC FIRE EXIT HARDWARE	QEL-99-NL-F	VON
1	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
1	EA	SURFACE CLOSER	4040XP / 4040XP EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	FIRE/LIFE WALL MAGNET	SEM 7800	LCN
1	EA	SEALS	188S	ZER
1	EA	CREDENTIAL READER	(BY DIVISION 28)	
1	EA	DOOR CONTACT	679 SERIES	SCE
1	EA	POWER SUPPLY	(BY DIVISION 28)	SCE
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	
1	EA	N/C F/A CONTACT	(BY F/A CONTRACTOR)	

FUNCTION: (NL) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED. A VALID CREDENTIAL WILL UNLOCK THE DOOR.

HW SET 10

1	EA	CONT. HINGE	112HD	IVE
	EA	CONT. HINGE	112HD	IVE
1	EA	CONT. HINGE	112HD EPT	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	KEYED REMOVABLE MULLION	KR-4954 STAB	VON
1	EA	PANIC HARDWARE	CD-99-DT	VON
1	EA	ELEC PANIC HARDWARE	QEL-99-NL	VON
1	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
2	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4040XP EDA	LCN
1	EA	SURF. AUTO OPERATOR	4642	LCN
2	EA	ACTUATOR, TOUCH	8310-853 / 8310-818	LCN
1	EA	RAIN DRIP	142	ZER
1	EA	MULLION SEAL	8780	ZER
	EA	WEATHERSTRIP	(BY DR/FR SUPPLIER)	
2	EA	DOOR SWEEP	8198	ZER
1	EA	THRESHOLD	(PROFILE AS REQUIRED)	ZER
1	EA	CREDENTIAL READER	(BY DIVISION 28)	
2	EA	DOOR CONTACT	679 SERIES	SCE
1	EA	POWER SUPPLY	(BY DIVISION 28)	SCE
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	

FUNCTION: (NL) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED. THIS DOOR HAS A POWER OPERATOR. INTERIOR ACTUATOR ALWAYS ACTIVE TO UNLOCK AND OPEN THE DOOR. A VALID CREDENTIAL WILL UNLOCK BOTH DOORS AND MAKE THE EXTERIOR ACTUATOR ACTIVE.

FUNCTION: (DT) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD. ACCESS FROM EXTERIOR WHEN EXIT DEVICE PUSH PAD IS DOGGED DOWN.

HW SET 11

	EA	HINGES	(AS SPECIFIED)	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	FIRE EXIT HARDWARE	9927-EO-F-LBR	VON
1	EA	ELEC FIRE EXIT HARDWARE	QEL-9927-NL-F-LBR	VON
1	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
2	EA	SURFACE CLOSER	4040XP / 4040XP EDA	LCN
2	EA	KICK PLATE	8400 10" X 1" LDW B-CS	IVE
1	EA	FIRE/LIFE WALL MAGNET	SEM 7800	LCN
1	EA	SEALS	188S	ZER
1	EA	MEETING STILE SEAL	S771	PEM
1	EA	CREDENTIAL READER	(BY DIVISION 28)	
2	EA	DOOR CONTACT	679 SERIES	SCE
1	EA	POWER SUPPLY	(BY DIVISION 28)	SCE
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	
1	EA	N/C F/A CONTACT	(BY F/A CONTRACTOR)	

FUNCTION: (NL) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED. A VALID CREDENTIAL RETRACTS LATCH BOLT AND PUSH PAD.

HW SET 12

1	EA	CONT. HINGE	112HD	IVE
1	EA	CONT. HINGE	112HD EPT	IVE
1	EA	POWER TRANSFER	EPT10	VON
1	EA	PANIC HARDWARE	LD-9947-EO	VON
1	EA	ELEC PANIC HARDWARE	QEL-9947-NL-OP	VON
1	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
1	EA	90 DEG OFFSET PULL	8190 10"	IVE
2	EA	SURFACE CLOSER	4040XP / 4040XP EDA	LCN
2	EA	FIRE/LIFE WALL MAGNET	SEM 7800	LCN
1	EA	ACCESS CONTROL	(BY DIVISION 28)	
2	EA	DOOR CONTACT	679 SERIES	SCE
1	EA	POWER SUPPLY	(BY DIVISION 28)	SCE
1	EA	WIRING DIAGRAMS	RISER & POINT-TO-POINT (BY HARDWARE SUPPLIER)	
1	EA	N/C F/A CONTACT	(BY F/A CONTRACTOR)	

FUNCTION: (NL) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED. A VALID CREDENTIAL RETRACTS LATCH BOLT AND PUSH PAD.

HW SET 13

2	EA	CONT. HINGE	112HD	IVE
1	EA	PANIC HARDWARE	CD-9947-EO	VON
1	EA	PANIC HARDWARE	CD-9947-NL-OP	VON
3	EA	INTERCHANGEABLE CORE	(CYLINDER AS REQUIRED)	SCH
2	EA	90 DEG OFFSET PULL	8190 10"	IVE
2	EA	SURFACE CLOSER	4040XP / 4040XP EDA	LCN
1	EA	FLOOR STOP/HOLDER	FS40	IVE
1	EA	WALL STOP & HOLDER	WS40	IVE

FUNCTION: (NL) LATCHBOLT RETRACTED INSIDE BY EXIT DEVICE PUSH PAD AND OUTSIDE BY KEY IN CYLINDER. DOOR LOCKS WHEN KEY IS REMOVED AND DOOR IS CLOSED.

**SECTION 088000
GLAZING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Insulating glass units.
- B. Glazing units.
- C. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 081213 - Hollow Metal Frames: Glazed borrowed lites.
- B. Section 081416 - Flush Wood Doors: Glazed lites in doors.
- C. Section 084313 - Aluminum-Framed Storefronts: Glazing furnished as part of storefront assembly.

1.03 REFERENCE STANDARDS

- A. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).
- B. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- C. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- D. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
- E. ITS (DIR) - Directory of Listed Products; Current Edition.
- F. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- G. NFPA 257 - Standard on Fire Test for Window and Glass Block Assemblies; 2022.
- H. UL (DIR) - Online Certifications Directory; Current Edition.
- I. UL 9 - Standard for Fire Tests of Window Assemblies; Current Edition, Including All Revisions.
- J. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- K. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- L. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- D. Samples: Submit one samples 12 by 12 inch in size of glass units.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

1.06 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 40 degrees F.

- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.07 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Insulating Glass Units: Provide a ten (10) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Float Glass Manufacturers:
 - 1. Cardinal Glass Industries: www.cardinalcorp.com/#sle.
 - 2. Guardian Industries Corp.: www.sunguardglass.com/#sle.
 - 3. Pilkington North America Inc.: www.pilkington.com/na.
 - 4. PPG Industries, Inc.: www.ppgideascales.com/#sle.
 - 5. Oldcastle, Inc..
 - 6. Substitutions: Refer to Section 016000 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

- A. Select type and thickness of exterior glazing assemblies to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of glass.
- B. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.
 - 1. In conjunction with vapor retarder and joint sealer materials described in other sections.
- C. Thermal and Optical Performance: Provide glass products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
 - 1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW computer program.
 - 2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW computer program.

2.03 GLASS MATERIALS

2.04 INSULATING GLASS UNITS

- A. Insulating Glass Units Manufacturers:
 - 1. Any of the manufacturers specified for float glass.
- B. Insulating Glass Units: Types as indicated.
 - 1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
 - 2. Warm-Edge Spacers: _____.
 - a. Spacer Width: As required for specified insulating glass unit.
 - b. Manufacturers:
 - 1) Basis of Design: Viracon VTS spacer.
 - 2) Substitutions: Refer to Section 016000 - Product Requirements.
 - 3. Spacer Color: Black.
 - 4. Edge Seal:
 - 5. Color: Black.
 - 6. Purge interpane space with dry air, hermetically sealed.
- C. Type IGU-1 - Insulating Glass Units: Vision glass, double glazed.
 - 1. Applications: Exterior glazing unless otherwise indicated.
 - 2. Space between lites filled with argon.
 - 3. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.

- b. Coating: Low-E (passive type), on #2 surface.
 - 4. Inboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 - 5. Total Thickness: 1 inch.
 - 6. Overall U-value within system: [.95] Btu/(hr sq ft deg F), maximum.
 - 7. Visible Light Transmittance (VLT): 57 percent, nominal.
 - 8. Solar Heat Gain Coefficient (SHGC): 25 percent, nominal.
 - 9. Glazing Method: Dry glazing method, gasket glazing.
- D. Type IGU-1A - Insulating Glass Units: Safety glazing.
 - 1. Applications:
 - a. Glazed lites in exterior doors.
 - b. Glazed sidelights and panels next to doors.
 - c. Other locations required by applicable federal, state, and local codes and regulations.
 - 2. Space between lites filled with argon.
 - 3. Glass Type: Same as Type IGU-1 except use heat soaked fully tempered float glass for both outboard and inboard lites.
 - 4. Total Thickness: 1 inch.

2.05 GLAZING COMPOUNDS

- A. Manufacturers:
 - 1. Bostik Inc: www.bostik-us.com.
 - 2. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com.
 - 3. Pecora Corporation: www.pecora.com.
 - 4. BASF Corporation: www.basf.com/us/en.html.
 - 5. Substitutions: Refer to Section 016000 - Product Requirements.

2.06 ACCESSORIES

- A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch x width of glazing rabbet space minus 1/16 inch x height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long x one half the height of the glazing stop x thickness to suit application, self adhesive on one face.
- C. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.
- D. Glazing Clips: Manufacturer's standard type.
- E. Drips at head.
- F. Flashing at sill.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that the minimum required face and edge clearances are being provided.
- C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
- D. Verify that sealing between joints of glass framing members has been completed effectively.

3.02 PREPARATION

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

- A. Install glazing sealants in accordance with ASTM C1193, GANA Sealant Manual, and manufacturer's instructions.
- B. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- C. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
- D. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
- E. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

- A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 CLEANING

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove non-permanent labels immediately after glazing installation is complete.
- C. Clean glass and adjacent surfaces after sealants are fully cured.
- D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.06 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
- B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

**SECTION 088300
MIRRORS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glass mirrors.
 - 1. Tempered safety glass.

1.02 REFERENCE STANDARDS

- A. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- B. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- C. GANA (GM) - GANA Glazing Manual; 2022.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data on Mirror Types: Submit structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Manufacturer's Certificate: Certify that mirrors, meets or exceeds specified requirements.

1.04 FIELD CONDITIONS

- A. Do not install mirrors when ambient temperature is less than 50 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.05 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Mirrors:
 - 1. Binswanger Mirror/ACI Distribution: www.binswangerglass.com/#sle.
 - 2. Lenoir Mirror Co: www.lenoirmirror.com/#sle.
 - 3. Trulite Glass and Aluminum Solutions: www.trulite.com/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.

2.02 MATERIALS

- A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.
- B. Mirror Glass: Clear, tempered safety glass; ASTM C1048, with copper and silver coatings, and protective overcoating.
 - 1. Thickness: 1/4 inch.
 - 2. Edges: Arrised.
 - 3. Size: As indicated on drawings.

2.03 ACCESSORIES

- A. Mirror Adhesive: Silicone pre-polymer based, chemically compatible with mirror coating and wall substrate.
 - 1. Application Temperature: Minus 35 to 140 degrees F at contact surfaces.
 - 2. Manufacturers:

- a. Liquid Nails, a brand of PPG Architectural Coatings; LN-730 Mirror Adhesive:
www.liquidnails.com/#sle.
- b. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.02 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.

3.03 INSTALLATION

- A. Install mirrors in accordance with manufacturer's recommendations.
- B. Set mirrors plumb and level, and free of optical distortion.
- C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.
- D. Frameless Mirrors: Set mirrors in proper place with adhesive, applied in accordance with adhesive manufacturer's instructions.

3.04 CLEANING

- A. Remove labels after work is complete.
- B. Clean mirrors and adjacent surfaces.

END OF SECTION

**SECTION 092116
GYPSUM BOARD ASSEMBLIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Metal channel ceiling framing.
- D. Acoustic insulation.
- E. Gypsum sheathing.
- F. Cementitious backing board.
- G. Gypsum wallboard.
- H. Joint treatment and accessories.
- I. Acoustic (sound-dampening) wall and ceiling board.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 092216 - Non-Structural Metal Framing.

1.03 REFERENCE STANDARDS

- A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023.
- B. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2018.
- C. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- D. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- E. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2023.
- F. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.
- G. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
- H. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- I. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2023.
- J. ASTM E413 - Classification for Rating Sound Insulation; 2022.
- K. ASTM E1414/E1414M - Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum; 2021a.
- L. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.
- M. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate special details associated with fireproofing and acoustic seals.
- C. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
- D. Product Data: Provide manufacturer's data on partition head to structure connectors, showing

compliance with requirements.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
 - 1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C. Shaft Walls at HVAC Shafts: Provide completed assemblies with the following characteristics:
 - 1. Air Pressure Within Shaft: Sustained loads of 5 lbf/sq ft with maximum mid-span deflection of L/240.
 - 2. Acoustic Attenuation: STC of 35-39 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- D. Fire-Resistance-Rated Assemblies: Provide completed assemblies with the following characteristics:
 - 1. Fire Rated Partitions, Ceilings, and Soffits : See Drawings.
 - 2. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.02 METAL FRAMING MATERIALS

- A. Manufacturers - Metal Framing, Connectors, and Accessories:
 - 1. ClarkDietrich Building Systems: www.clarkdietrich.com/#sle.
 - 2. Jaimes Industries: www.jaimesind.com/#sle.
 - 3. Marino: www.marinoware.com/#sle.
 - 4. Steel Construction Systems: www.steelconsystems.com/#sle.
 - 5. Phillips Manufacturing Company: www.phillipsmfg.com.
 - 6. Substitutions: See Section 016000 - Product Requirements.
- B. Non-structural Steel Framing for Application of Gypsum Board: As specified in Section 092216.
- C. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/120 at 5 psf.
 - 1. Studs: "C" shaped with flat or formed webs with knurled faces.
 - 2. Ceiling Channels: C-shaped.
 - 3. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
- D. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 and specified performance requirements.
- E. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
- F. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
 - 1. Material: ASTM A653/A653M steel sheet, SS Grade 50/340, with G60/Z180 hot dipped galvanized coating.
 - 2. Deflection and Firestop Track:
 - a. Provide mechanical anchorage devices as described above that accommodate deflection while maintaining the fire-rating of the wall assembly.
- G. Grid Suspension Systems: Steel grid system of main tees and support bars connected to structure using hanging wire.

2.03 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 - 1. American Gypsum Company: www.americangypsum.com/#sle.

2. CertainTeed Corporation: www.certainteed.com/#sle.
 3. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
 4. National Gypsum Company: www.nationalgypsum.com/#sle.
 5. USG Corporation: www.usg.com/#sle.
 6. Substitutions: See Section 016000 - Product Requirements.
- B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
 2. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 3. Thickness:
 - a. Vertical Surfaces: 5/8 inch.
 - b. Ceilings: 5/8 inch.
 4. Paper-Faced Products:
 - a. American Gypsum Company; LightRoc Gypsum Wallboard.
 - b. CertainTeed Corporation; Type C Drywall.
 - c. Georgia-Pacific Gypsum; ToughRock.
 - d. National Gypsum Company; Gold Bond BRAND Fire-Shield Gypsum Board.
 5. Mold Resistant Paper Faced Products:
 - a. American Gypsum Company; M-Bloc.
 - b. CertainTeed Corporation; M2Tech 5/8" Type C Moisture & Mold Resistant Drywall.
 - c. Georgia-Pacific Gypsum; ToughRock Mold-Guard.
 - d. National Gypsum Company; Gold Bond XP Gypsum Board.
 - e. Substitutions: See Section 016000 - Product Requirements.
 6. Glass Mat Faced Products:
 - a. Continental Building Products; Weather Defense Platinum Interior.
 - b. Georgia-Pacific Gypsum; DensArmor Plus.
 - c. National Gypsum Company; Gold Bond eXP Interior Extreme Gypsum Panel.
 - d. USG Corporation; USG Sheetrock Brand Glass-Mat Panels Mold Tough.
 - e. Substitutions: See Section 016000 - Product Requirements.
 7. Glass Mat Faced Board: Coated glass mat water-resistant gypsum backing panel as defined in ASTM C1178/C1178M.
 - a. Regular Type: Thickness 1/2 inch.
 - b. Products:
 - 1) Georgia-Pacific Gypsum; DensShield Tile Backer.
 - 2) National Gypsum Company; Gold Bond eXP Tile Backer.
 - 3) Substitutions: See Section 016000 - Product Requirements.
- C. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Ceilings, unless otherwise indicated.
 2. Thickness: 5/8 inch.
 3. Edges: Tapered.
 4. Products:
 - a. American Gypsum; Interior Ceiling Board.
 - b. CertainTeed Corporation; ProRoc Interior Ceiling.
 - c. Georgia-Pacific Gypsum; ToughRock Span 24 Ceiling Board.
 - d. Lafarge North America Inc; Sagcheck.
 - e. National Gypsum Company; High Strength Brand Ceiling Board.
 - f. Pacific Coast Building Products, Inc; PABCO Ceiling Board.
 - g. USG Corporation; Sheetrock Brand Sag-Resistant Interior Gypsum Ceiling Board.
 - h. Substitutions: See Section 016000 - Product Requirements.
- D. Ceiling Board For Wet Areas: Mold and moisture resistant gypsum ceiling board with fiberglass

mats as defined in ; sizes to minimize joints in place; ends square cut.

1. Application: Ceilings in wet areas, unless otherwise indicated.
 2. Thickness: 5/8 inch.
 3. Edges: Tapered.
 4. Products:
 - a. Basis of Design: Georgia-Pacific Gypsum; DensArmor Plus.
 - b. Substitutions: See Section 016000 - Product Requirements.
- E. Sound-Absorbing Gypsum Board Ceiling System: Perforated gypsum board with acoustic backer panels and spray-applied finish.
1. Thickness, Perforated Gypsum Board: 5/8 inch.
 2. Thickness, Backer Panels: 1 inch.
 3. Spray-Applied Finish: Acoustically transparent, acrylic-based finish coating.
 4. Noise Reduction Coefficient (NRC): Not less than 0.80 when measured and calculated in accordance with ASTM C423.
 5. Ceiling Attenuation Class (CAC): Not less than 44 when tested in accordance with ASTM E1414/E1414M and classified in accordance with ASTM E413.
 6. Products:
 - a. USG Corporation; Ensemble Acoustical Drywall Ceiling System: www.usg.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.04 GYPSUM WALLBOARD ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 6 inch.
- B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
1. Products:
 - a. Franklin International, Inc; Titebond GREENchoice Professional Acoustical Smoke and Sound Sealant: www.titebond.com/#sle.
 - b. Liquid Nails, a brand of PPG Architectural Coatings; AS-825 Acoustical Sound Sealant: www.liquidnails.com/#sle.
 - c. Specified Technologies Inc; Smoke N Sound Acoustical Sealant: www.stifirestop.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
- C. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, galvanized steel, or rolled zinc, unless noted otherwise.
1. Expansion Joints:
 - a. Type: V-shaped PVC with tear away fins.
- D. Decorative Metal Trim:
1. Material: Extruded aluminum alloy 6063-T5 temper.
 2. Finish: Anodized, Dark Bronze color.
 3. Type: As shown on drawings.
 4. Corner Trim:
 - a. Products:
 - 1) Basis of Design: Fry Reglet DMCT-375 .
 - 2) Substitutions: See Section 016000 - Product Requirements.
 5. Paper Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
 6. Ready-mixed vinyl-based joint compound.
 7. Chemical hardening type compound.
- E. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.

- F. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion resistant.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.02 SHAFT WALL INSTALLATION

- A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
 - 1. Install studs at spacing required to meet performance requirements.
- B. Shaft Wall Liner: Cut panels to accurate dimensions and install sequentially between special friction studs.

3.03 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members at 16 inches on center.
- C. Studs: Space studs at 16 inches on center.
 - 1. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- E. Blocking: Install wood blocking for support of:
 - 1. Framed openings.
 - 2. Wall mounted cabinets.
 - 3. Plumbing fixtures.
 - 4. Toilet partitions.
 - 5. Toilet accessories.
 - 6. Wall mounted door hardware.

3.04 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

3.05 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- C. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.

3.06 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints consistent with lines of building spaces and as follows:
 - 1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
- B. Corner Beads: Install at external corners, using longest practical lengths.
- C. Decorative Trim: Install at locations shown on drawings and in accordance with manufacturer's instructions.

3.07 JOINT TREATMENT

- A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.

- B. Paper Faced Gypsum Board: Use paper joint tape, bedded with ready-mixed vinyl-based joint compound and finished with ready-mixed vinyl-based joint compound.

END OF SECTION

**SECTION 092216
NON-STRUCTURAL METAL FRAMING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal partition, ceiling, and soffit framing.
- B. Framing accessories.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Wood blocking within stud framing.
- B. Section 09 2116 - Gypsum Board Assemblies: Metal studs for gypsum board partition framing.

1.03 REFERENCE STANDARDS

- A. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2018.
- B. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2020.
- C. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data describing framing member materials and finish, product criteria, load charts, and limitations.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Framing, Connectors, and Accessories:
 - 1. Clarkwestern Dietrich Building Systems LLC: www.clarkdeitrich.com.
 - 2. Marino: www.marinoware.com/#sle.
 - 3. Simpson Strong Tie: www.strongtie.com/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.

2.02 FRAMING MATERIALS

- A. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
 - 1. Studs: C shaped with flat or formed webs with knurled faces.
 - 2. Runners: U shaped, sized to match studs.
 - 3. Ceiling Channels: C shaped.
 - 4. Furring: Hat-shaped and Z shaped sections, minimum depth of 7/8 inch.
 - 5. Steel Stud Framing Connectors:
 - a. Products:
 - 1) Simpson Strong Tie, Bridging Connectors; DBC Bridging Connector: www.strongtie.com.
 - 2) Substitutions: See Section 016000 - Product Requirements.
- B. Loadbearing Studs: As specified in Section 054000.
- C. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
- D. Partition Head to Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short .
- E. Tracks and Runners: Same material and thickness as studs, bent leg retainer notched to receive studs with provision for crimp locking to stud.
- F. Fasteners: ASTM C1002 self-piercing tapping screws.

- G. Anchorage Devices: Powder actuated.

2.03 FABRICATION

- A. Fabricate assemblies of framed sections to sizes and profiles required.
- B. Fit, reinforce, and brace framing members to suit design requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that rough-in utilities are in proper location.

3.02 INSTALLATION OF STUD FRAMING

- A. Extend partition framing to structure where indicated and to ceiling in other locations.
- B. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
- C. Align and secure top and bottom runners at 24 inches on center.
- D. Fit runners under and above openings; secure intermediate studs to same spacing as wall studs.
- E. Align stud web openings horizontally.
- F. Secure studs to tracks using crimping method. Do not weld.
- G. Fabricate corners using a minimum of three studs.
- H. Double stud at wall openings, door and window jambs, not more than 2 inches from each side of openings.
- I. Coordinate installation of bucks, anchors, and blocking with electrical, mechanical, and other work to be placed within or behind stud framing.

3.03 CEILING AND SOFFIT FRAMING

- A. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- B. Install furring independent of walls, columns, and above-ceiling work.
- C. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.
- D. Space main carrying channels at maximum 72 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.
- E. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- F. Place furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.

3.04 TOLERANCES

- A. Maximum Variation From True Position: 1/8 inch in 10 feet.
- B. Maximum Variation From Plumb: 1/8 inch in 10 feet.

END OF SECTION

**SECTION 093000
TILING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Coated glass mat backer board as tile substrate.
- D. Ceramic accessories.
- E. Non-ceramic trim.

1.02 RELATED REQUIREMENTS

- A. Section 079200 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
- B. Section 092116 - Gypsum Board Assemblies: Tile backer board.

1.03 REFERENCE STANDARDS

- A. ANSI A108/A118/A136.1 - Specifications for the Installation of Ceramic Tile; 2020.
- B. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.
- C. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive; 2021.
- D. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar; 2023.
- E. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation; 2019.
- F. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014 (Reaffirmed 2024).
- G. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2022.
- H. ASTM C1178/C1178M - Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel; 2018.
- I. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2024.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches in size illustrating pattern, color variations, and grout joint size variations.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Installer's Qualification Statement:
- F. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 016000 - Product Requirements, for additional provisions.
2. Extra Tile: 5 percent of each size, color, and surface finish combination.

1.06 QUALITY ASSURANCE

- A. Maintain one copy of and ANSI A108/A118/A136.1 and TCNA (HB) on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
- C. Installer Qualifications:
 1. Company specializing in performing tile installation, with minimum of five years of documented experience.

1.07 MOCK-UP

- A. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location.
 1. Approved mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.09 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature of 50 degrees F during installation of mortar materials.

PART 2 PRODUCTS

2.01 TILE

- A. Manufacturers:
 1. Dal-Tile Corporation: www.daltile.com/#sle.
 2. Substitutions: See Section 016000 - Product Requirements.
- B. Porcelain Floor & Wall Tile Type PT-1 and PT-4: ANSI A137.1, and as follows:
 1. Bryne manufactured by Daltile .
 2. Moisture Absorption: 0 to 0.5 percent.
 3. Size and Shape: See Finish Schedule.
 4. Surface Finish: See Finish Schedule.
 5. Color(s): See Finish Schedule.
 6. Pattern: See Drawings.
 7. Products:
 - a. Substitutions: See Section 016000 - Product Requirements.

2.02 TRIM AND ACCESSORIES

- A. Non-Ceramic Trim: See Finish Schedule for finish, style and dimensions to suit application, for setting using tile mortar or adhesive.
 1. Applications:
 - a. Open edges of wall tile.
 - b. Open edges of floor tile.
 - c. Wall corners, outside and inside.
 - d. Transition between floor finishes of different heights.
 - e. Thresholds at door openings.
 - f. Expansion and control joints, floor and wall as indicated on Drawings.
 - g. Floor to wall joints.
 - h. Borders and other trim as indicated on drawings.
 2. Manufacturers:
 - a. Schluter-Systems: www.schluter.com/#sle.
 - b. Genesis APS International: www.genesis-aps.com/#sle.

2.03 SETTING MATERIALS

- A. Provide setting and grout materials from same manufacturer.
- B. Manufacturers:
 - 1. ARDEX Engineered Cements: www.ardexamericas.com/#sle.
 - 2. Bostik Inc: www.bostik-us.com/#sle.
 - 3. Custom Building Products: www.custombuildingproducts.com/#sle.
 - 4. LATICRETE International, Inc: www.laticrete.com/#sle.
 - 5. Merkrete, by Parex USA, Inc: www.merkrete.com/sle.
 - 6. ProSpec, an Oldcastle brand: www.prospec.com.
- C. Provide setting materials made by the same manufacturer as grout.
- D. Latex-Portland Cement Mortar Bond Coat:
 - 1. Products:
 - a. ARDEX Engineered Cements; ARDEX X 77 MICROTEC: www.ardexamericas.com.
 - b. AVM Industries, Inc; Thin-Set 780: www.avmindustries.com.
 - c. LATICRETE International, Inc; LATICRETE 254 Platinum: www.laticrete.com.
 - d. Substitutions: See Section 016000 - Product Requirements.

2.04 GROUTS

- A. Provide setting and grout materials from same manufacturer.
- B. Manufacturers:
 - 1. ARDEX Engineered Cements: www.ardexamericas.com/#sle.
 - 2. LATICRETE International, Inc; LATICRETE PERMACOLOR Grout: www.laticrete.com/#sle.
 - 3. Basis of Design: Mapei.
 - 4. Substitutions: See Section 016000 - Product Requirements.
- C. Standard Grout: ANSI A118.6 standard cement grout.
 - 1. Applications: Use this type of grout where indicated and where no other type of grout is indicated.
 - 2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
 - 3. Color(s): As indicated on drawings.
 - 4. Products:
 - a. LATICRETE International, Inc; LATICRETE 1500 Sanded Grout: www.laticrete.com/#sle.
- D. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
 - 1. Color(s): As indicated on drawings.
 - 2. Products:
 - a. LATICRETE International, Inc; LATICRETE SPECTRALOCK PRO Premium Grout: www.laticrete.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- E. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
 - 1. Composition: Water-based colorless silicone.

2.05 ACCESSORY MATERIALS

- A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
 - 1. Thickness: 20 mils, maximum.
 - 2. Crack Resistance: No failure at 1/16 inch gap, minimum.
 - 3. Products:
 - a. LATICRETE International, Inc; LATICRETE Blue 92 Anti-Fracture Membrane:

www.laticrete.com/#sle.

- b. Substitutions: See Section 016000 - Product Requirements.
- B. Backer Board: Coated glass mat type complying with ASTM C1178/C1178M; inorganic fiberglass mat on both surfaces and integral acrylic coating vapor retarder.
- C. Mesh Tape: 2 inch wide self-adhesive fiberglass mesh tape.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.
- D. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer.
- E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.

3.03 INSTALLATION - GENERAL

- A. Install tile, thresholds, and stair treads and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.13, manufacturer's instructions, and TCNA (HB) recommendations.
- B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- E. Form internal angles square and external angles bullnosed.
- F. Install non-ceramic trim in accordance with manufacturer's instructions.
- G. Sound tile after setting. Replace hollow sounding units.
- H. Keep control and expansion joints free of mortar, grout, and adhesive.
- I. Keep expansion joints free of adhesive or grout. Apply sealant to joints.
- J. Prior to grouting, allow installation to completely cure; minimum of 48 hours.
- K. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- L. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.
- M. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.04 INSTALLATION - WALL TILE

- A. Over coated glass mat backer board on studs, install in accordance with TCNA (HB) Method

W245.

3.05 CLEANING

A. Clean tile and grout surfaces.

3.06 PROTECTION

A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

**SECTION 095100
ACOUSTICAL CEILINGS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.02 REFERENCE STANDARDS

- A. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2022.
- B. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2023.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on suspension system components.
- C. Samples: Submit two samples 6 by 6 inch in size illustrating material and finish of acoustical units.
- D. Samples: Submit one samples each, 6 inches long, of suspension system main runner.
- E. Manufacturer's Installation Instructions: Indicate special procedures.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.05 QUALITY ASSURANCE

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

- A. Manufacturers: Basis of Design: USG
 - 1. Armstrong World Industries, Inc: www.armstrong.com.
 - 2. Acoustic Ceiling Products, Inc.: www.acpideas.com.
 - 3. CertainTeed Corporation: www.certainteed.com.
 - 4. Hunter Douglas Contract: www.hunterdouglascontract.com.
 - 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Acoustical Panels Type ACT-1: Painted mineral fiber, ASTM E1264 Type III, with the following characteristics:
 - 1. Size: 24 by 24 inches.
 - 2. Thickness: 5/8 inches.

3. Composition: Formed Mineral Fiber.
4. NRC: .55.
5. CAC: 33.
6. Edge: Square.
7. Surface Color: White.
8. Products:
 - a. Basis of Design: Radar by USG.
 - b. Substitutions: See Section 016000 - Product Requirements.
9. Suspension System: Exposed grid.

2.02 SUSPENSION SYSTEM(S)

- A. Manufacturers:
 1. Armstrong World Industries, Inc: www.armstrong.com.
 2. Acoustic Ceiling Products, Inc.: www.acpideas.com.
 3. CertainTeed Corporation: www.certainteed.com.
 4. Chicago Metallic Corporation: www.chicagometallic.com.
 5. Hunter Douglas Contract: www.hunterdouglascontract.com.
 6. USG: www.usg.com.
 7. Substitutions: See Section 01 6000 - Product Requirements.
- B. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
- C. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; heavy-duty.
 1. Profile: Tee; 15/16 inch wide face.
 2. Construction: Double web.
 3. Finish: White painted.
 4. Products:
 - a. Basis of Design: Donn DX by USG.
 - b. Substitutions: See Section 016000 - Product Requirements.

2.03 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Hanger Wire: 12-gage 0.08 inch galvanized steel wire.
- C. Perimeter Moldings: Same material and finish as grid.
 1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid. Basis of Design: Armstrong Axiom 4" profile.
- D. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.02 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.

3.03 INSTALLATION - SUSPENSION SYSTEM

- A. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- B. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with

other interruptions.

1. Use longest practical lengths.
- C. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- D. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- E. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- F. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- G. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- H. Do not eccentrically load system or induce rotation of runners.
- I. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
1. Use longest practical lengths.
 2. Overlap and rivet corners.

3.04 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install units after above-ceiling work is complete.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
1. Make field cut edges of same profile as factory edges.

3.05 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

END OF SECTION

**SECTION 096500
RESILIENT FLOORING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient tile flooring.
- B. Resilient base.
- C. Installation accessories.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

1.03 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2023.
- B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- C. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile; 2023.
- D. ASTM F1344 - Standard Specification for Rubber Floor Tile; 2021a.
- E. ASTM F1861 - Standard Specification for Resilient Wall Base; 2021.
- F. ASTM F2169 - Standard Specification for Resilient Stair Treads; 2015 (Reapproved 2020).
- G. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2023.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Verification Samples: Submit two samples, 12 by 12 inch in size illustrating color and pattern for each resilient flooring product specified.
- D. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Flooring Material: 5% of square feet of each type and color.
 - 3. Extra Wall Base: 5% of linear feet of each type and color.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum five years documented experience.
- B. Installer Qualifications: Company specializing in installing specified flooring with minimum five years experience and approved by flooring manufacturer.
- C. The resilient stage floor installation shall be the responsibility of a single Contractor, including moisture barrier, anchorage system, sleepers, resilient mounts, adhesives, acoustical batting, sub-flooring, flooring, trim, expansion provisions, and finish. This Contractor shall assume complete responsibility for the installation of the work in this Section, and shall hold the Owner, Architect, Theater Consultant, and all their Employees and Consultants harmless for any costs for errors or omissions associated with the work of this Section and any action arising therefrom.
- D. The Contractor shall obtain all flooring from single manufacturer or source to ensure match of

quality, color, pattern, and texture.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year warranty for resilient stage floor to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- D. Protect roll materials from damage by storing on end.
- E. Do not double stack pallets.
- F. Place wood flooring materials in stage area at least 7 days in advance of start of installation. Open sealed packages of wood flooring to permit natural adjustment of moisture content.

1.08 FIELD CONDITIONS

- A. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- B. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 SHEET FLOORING

2.02 TILE FLOORING

- A. Vinyl Plank: RST-1: Printed film type, with transparent or translucent wear layer, and:
 - 1. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.
 - 2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
 - 3. Size: 9 X 48 inches.
 - 4. Wear Layer Thickness: .020 inch.
 - 5. Total Thickness: .098 inch.
 - 6. Pattern: 1746V.
 - 7. Color: See Finish Legend.
 - 8. Manufacturers:
 - a. Basis of Design: Patcraft; Product Polychrome
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- B. Vinyl Plank: RST-2A & RST-2B Printed film type, with transparent or translucent wear layer, and:
 - 1. Minimum Requirements: Comply with ASTM F1700, of Class corresponding to type specified.
 - 2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
 - 3. Size: 9x36 inch.
 - 4. Wear Layer Thickness: .020 inch.
 - 5. Total Thickness: .32 inch.
 - 6. Manufacturers:
 - a. Tarkett; Product Color Pop, PCOP
 - b. Substitutions: See Section 01 6000 - Product Requirements.
- C. Rubber Tile - Type RFT-1 & RFT-2: Homogeneous, color and pattern throughout thickness.

1. Manufacturers:
 - a. Basis of Design: Sophros by Zandur.
 - b. Substitutions: See Section 016000 - Product Requirements.
2. Minimum Requirements: Comply with ASTM F1344, of Class corresponding to type specified.
3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648, NFPA 253, ASTM E 648, or NFPA 253.
4. Size: 23.2 by 46.4 inch nominal.
5. Thickness: 6.0 mm.
6. Color: See Finish Legend.

2.03 RESILIENT BASE

- A. Resilient Base - Type VB-1: ASTM F1861, Type TP, rubber, thermoplastic; top set Style B, Cove.
 1. Manufacturers: Basis of Design: Rubber Cove Base by Allstate Rubber
 - a. Burke Flooring: www.burkeflooring.com/#sle.
 - b. Johnsonite, a Tarkett Company; _____: www.johnsonite.com/#sle.
 - c. Roppe Corp: www.roppe.com/#sle.
 - d. Substitutions: See Section 016000 - Product Requirements.
 2. Height: 4 inch.
 3. Thickness: 0.125 inch.
 4. Finish: Matte.
 5. Color: See Finish Schedule.
 6. Accessories: Premolded external corners and internal corners.

2.04 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.
- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- C. Filler for Coved Base: Plastic.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.

3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
- C. Prohibit traffic until filler is fully cured.
- D. Clean substrate.

3.03 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Adhesive-Applied Installation:
 1. Spread only enough adhesive to permit installation of materials before initial set.
 2. Fit joints and butt seams tightly.

- 3. Set flooring in place, press with heavy roller to attain full adhesion.
- D. Loose-Laid Installation: Set flooring in place in accordance with manufacturer's instructions.
- E. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- F. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- G. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- H. Install flooring in recessed floor access covers, maintaining floor pattern.
- I. At movable partitions, install flooring under partitions without interrupting floor pattern.
- J. Spread only enough adhesive to permit installation of materials before initial set.
- K. Fit joints and butt seams tightly.
- L. Set flooring in place, press with heavy roller to attain full adhesion.
- M. Where type of floor finish, pattern, or color are different on opposite sides of door, terminate flooring under centerline of door.
- N. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated.
- O. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.

3.04 INSTALLATION - TILE FLOORING

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

3.05 INSTALLATION - RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.

3.06 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.07 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

**SECTION 096566
RESILIENT ATHLETIC FLOORING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Rubber sheet flooring, adhesively installed.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors to receive adhesive-applied flooring.
- B. Section 096500 - Resilient Flooring.

1.03 REFERENCE STANDARDS

- A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).
- B. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).
- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- F. ASTM F2772 - Standard Specification for Athletic Performance Properties of Indoor Sports Floor Systems; 2011 (Reapproved 2019).

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed data sheets for products specified.
- C. Shop Drawings: Fabrication and installation details, and layout, colors, and widths of game lines and equipment locations.
- D. Selection Samples: Manufacturer's color charts for flooring materials specified, indicating full range of colors and textures available.
- E. Verification Samples: Actual flooring material specified, not less than 12 inch square, mounted on solid backing.
- F. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- G. Manufacturer's Instructions: Indicate standard and special installation procedures.
- H. Installer's qualification statement.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Flooring Material: 4 square yards matching installed flooring.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in unopened containers clearly labeled with manufacturer's name and identification of contents.

- B. Store materials in dry and clean location until needed for installation. During installation, handle in a manner that will prevent marring and soiling of finished surfaces.

1.07 FIELD CONDITIONS

- A. Maintain temperature in spaces to receive adhesively installed resilient flooring within range of 70 to 95 degrees F for not less than 48 hours before the beginning of installation and for not less than 48 hours after installation has been completed. Subsequently, do not allow temperature in installed spaces to drop below 50 degrees F or to go above 100 degrees F.

PART 2 PRODUCTS

2.01 PREFORMED ATHLETIC FLOORING

- A. Rubber Sheet Flooring RAF-1: Two-layer vulcanized rubber.
 - 1. Thickness: minimum 14.5 mm.
 - 2. Sheet Width: Minimum 48 inches.
 - 3. Surface Texture: Smooth.
 - 4. Color: As indicated on drawings.
 - 5. Products:
 - a. Substitutions: See Section 016000 - Product Requirements.

2.02 ACCESSORIES

- A. Leveling Compound: Latex-modified cement formulation as recommended by flooring manufacturer for substrate conditions.
- B. Flooring Adhesive: Waterproof; types recommended by flooring manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates for conditions detrimental to installation of athletic flooring. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of athletic flooring to substrate.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for resilient flooring installation by testing for moisture and alkalinity (pH).
 - 1. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Concrete: Use leveling compound as necessary to achieve substrate flatness of plus or minus 1/8 inch within 10 ft radius.
- C. Remove coatings that are incompatible with flooring adhesives, using methods recommended by flooring manufacturer.
- D. Broom clean areas to receive athletic flooring immediately before beginning installation.

3.03 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install in accordance with manufacturer's written instructions.
- C. Resilient Sheet Flooring:
 - 1. Unroll flooring and allow to relax before beginning installation.
 - 2. Mix adhesive thoroughly and apply to substrate with notched trowel. Roll flooring into fresh adhesive, overlapping end seams and double cutting, butting factory edges and compression fitting.

3. Roll entire flooring surface with steel roller to assure adhesion to substrate and eliminate air bubbles.
4. Immediately remove any adhesive from flooring surface, using chemical recommended by flooring manufacturer.
5. Weld seams using techniques and equipment recommended by manufacturer.
6. Lay out game lines using tape and taping machine approved by flooring manufacturer. Apply game line paint with roller, and allow to dry before removing tape.
7. Apply transparent top coat over flooring if recommended by manufacturer, to achieve a uniform finished appearance.

3.04 CLEANING

- A. Clean flooring using methods recommended by manufacturer.

3.05 PROTECTION

- A. Protect finished athletic flooring from construction traffic to ensure that it is without damage upon Date of Substantial Completion.

END OF SECTION

**SECTION 096813
TILE CARPETING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Carpet tile, loose laid with edges and control grid adhered.

1.02 REFERENCE STANDARDS

- A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016 (Reapproved 2021).
- B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- C. CRI (CIS) - Carpet Installation Standard; Carpet and Rug Institute; 2011.
- D. CRI (GLA) - Green Label Testing Program - Approved Adhesive Products; Carpet and Rug Institute; Current Edition.

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Shop Drawings: Indicate pattern and layout direction.
- D. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- E. Manufacturer's Installation Instructions: Indicate special procedures.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.
- H. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.
- I. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

1.05 FIELD CONDITIONS

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Tile Carpeting:
 - 1. Tarkett
 - 2. Patcraft.
 - 3. Substitutions: See Section 016000 - Product Requirements.

2.02 MATERIALS

- A. Carpet Tile Type CPT-1: Tufted Pattern Loop, manufactured in one color dye lot.
 - 1. Product: Grounded Harmony manufactured by Tarkett.

2. Tile Size: 18" x 36", nominal.
 3. Color: 24708 Join.
 4. Gage: 1/10 inch.
 5. Stitches: 10 per inch.
 6. Pile Thickness: .130 inches
 7. Installation Method: Monolithic.
- B. Carpet Tile Type WOC-1: Tufted tip-Sheared, manufactured in one color dye lot.
1. Product: Walk Forward manufactured by Patcraft.
 2. Tile Size: 24 x 24, nominal.
 3. Color: 560 Saunter.
 4. Gage: 1/12 inch.
 5. Stitches: 10 per inch.
 6. Weight: 28 oz/sq yd
 7. Primary Backing Material: Synthetic
 8. Installation Method: Quarter Turn

2.03 ACCESSORIES

- A. Sub-Floor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Edge Strips: Rubber, color as selected by Architect.
- C. Adhesives: Acceptable to carpet tile manufacturer, compatible with materials being adhered; maximum VOC of 50 g/L; CRI Green Label certified; in lieu of labeled product, independent test report showing compliance is acceptable.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive carpet tile.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.
- D. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and pH.

3.02 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
- C. Vacuum clean substrate.

3.03 INSTALLATION

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions.
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
- F. Trim carpet tile neatly at walls and around interruptions.
- G. Complete installation of edge strips, concealing exposed edges.

3.04 CLEANING

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

END OF SECTION

**SECTION 098430
SOUND-ABSORBING WALL AND CEILING UNITS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sound-absorbing panels.
- B. Mounting accessories.

1.02 RELATED REQUIREMENTS

- A. Section 099123 - Interior Painting.

1.03 REFERENCE STANDARDS

- A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2023.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- C. ASTM E795 - Standard Practices for Mounting Test Specimens during Sound Absorption Tests; 2023.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed data sheets for products specified.
- C. Shop Drawings: Fabrication and installation details, panel layout, and fabric orientation.
- D. Verification Samples: Fabricated samples of each type of panel specified; 12 by 12 inch, showing construction, edge details, and fabric covering.
- E. Test Reports: Certified test data from an independent test agency verifying that panels meet specified requirements for acoustical and fire performance.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Panels: Quantity equal to 5 percent of total installed, but not less than one of each type.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company with not less than five years of experience in manufacturing acoustical products similar to those specified.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect acoustical units from moisture during shipment, storage, and handling. Deliver in factory-wrapped bundles; do not open bundles until units are needed for installation.
- B. Store units flat, in dry, well-ventilated space; do not stand on end.
- C. Protect edges from damage.

PART 2 PRODUCTS

2.01 FABRIC-COVERED SOUND-ABSORBING UNITS

- A. Manufacturers:
 - 1. Basis of Design: Silent Night by G&S Acoustics.
 - 2. Substitutions: See Section 016000 - Product Requirements.
- B. Sound Absorbing Units: Prefinished, factory assembled fabric panels.
 - 1. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
- C. Fabric Acoustical Panels for Walls (AMP-1 & AWP-3):
 - 1. Panel Core: Manufacturer's standard rigid or semi-rigid fiberglass core.

2. Core Density: 6 to 7 lb/cu ft.
3. Noise Reduction Coefficient (NRC): .80 when tested in accordance with ASTM C423 for Type I mounting, per ASTM E795.
4. Panel Size: 48 inches by 96 inches.
5. Panel Thickness: 1 inch.
6. Edges: Perimeter edges reinforced by a formulated resin hardener.
7. Corners: Square.
8. Color: Black Matte.
9. Mounting Method: Hat channel / direct mount & bolt & nut / back to back.

2.02 FABRICATION

- A. Fabric Wrapped, General: Fabricate panels to sizes and configurations as indicated, with fabric facing installed without sagging, wrinkles, blisters, or visible seams.
 1. Where radiused or mitered corners are indicated, install fabric to avoid seams or gathering of material.
 2. For panels suspended from ceiling, provide fabric covering both sides, with seams only at panel edges.
- B. Tolerances: Fabricate to finished tolerance of plus or minus 1/16 inch for thickness, overall length and width, and squareness from corner to corner.

2.03 ACCESSORIES

- A. Fixing Clips: Manufacturers standard for application as indicated.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates for conditions detrimental to installation of acoustical units. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Install acoustical units in locations indicated, following manufacturer's installation instructions.
- B. Align panels accurately, with edges plumb and top edges level. Scribe to fit accurately at adjoining work and penetrations.
- C. Install acoustical units to construction tolerances of plus or minus 1/16 inch for the following:
 1. Plumb and level.
 2. Flatness.
 3. Width of joints.

3.03 CLEANING

- A. Clean fabric facing upon completion of installation from dust and other foreign materials, following manufacturer's instructions.

3.04 PROTECTION

- A. Provide protection of installed acoustical panels until completion of the work.
- B. Replace panels that cannot be cleaned and repaired to satisfaction of the Architect.

END OF SECTION

**SECTION 099000
PAINTING AND COATING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish all interior and exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - 1. Exposed surfaces of steel lintels and ledge angles.
 - 2. Mechanical and Electrical:
 - a. In finished areas, paint all insulated and exposed pipes, unless otherwise indicated.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items fully factory-finished unless specifically so indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Floors, unless specifically so indicated.
 - 6. Glass.
 - 7. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

- A. Section 055000 - Metal Fabrications: Shop-primed items.

1.03 REFERENCE STANDARDS

- A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.
- B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of all products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
- D. Samples: Submit two painted samples, illustrating selected colors and textures for each color and system selected with specified coats cascaded. Submit on aluminum sheet, 4 x 8 inch in size.
- E. Manufacturer's Instructions: Indicate special surface preparation procedures.
- F. Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.07 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide all paint and coating products used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
 - 1. Diamond Vogel Paints: www.diamondvogel.com/#sle.
 - 2. Duron, Inc: www.duron.com/#sle.
 - 3. Glidden Professional, a product of PPG Architectural Coatings: www.gliddenprofessional.com.
 - 4. Benjamin Moore & Co: www.benjaminmoore.com/#sle.
 - 5. PPG Paints: www.ppgpaints.com/#sle.
 - 6. Pratt & Lambert Paints: www.prattandlambert.com/#sle.
 - 7. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
- C. Primer Sealers: Same manufacturer as top coats.
- D. Block Fillers: Same manufacturer as top coats.
- E. Substitutions: See Section 016000 - Product Requirements.

2.02 PAINTS AND COATINGS - GENERAL

- A. Paints and Coatings: Ready mixed, unless intended to be a field-catalyzed coating.
 - 1. Provide paints and coatings of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Supply each coating material in quantity required to complete entire project's work from a single production run.
 - 3. Do not reduce, thin, or dilute coatings or add materials to coatings unless such procedure is specifically described in manufacturer's product instructions.
- B. Primers: As follows unless other primer is required or recommended by manufacturer of top coats; where the manufacturer offers options on primers for a particular substrate, use primer categorized as "best" by the manufacturer.
- C. Flammability: Comply with applicable code for surface burning characteristics.

- D. Colors: To be selected from manufacturer's full range of available colors.
 - 1. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

2.03 PAINT SYSTEMS - EXTERIOR

- A. Paint ME-OP-2A - Ferrous Metals, Primed, Alkyd, 2 Coat:
 - 1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
 - 2. Semi-gloss: Two coats of alkyd enamel; Devoe's DevGuard Semi-Gloss Alkyd 4306-xxxx.

2.04 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP-DF - Dry Fall: Metals; exposed structure and overhead-mounted services in utilitarian spaces, including shop primed steel deck.
 - 1. Shop primer by others.
 - 2. Intermediate Coat: same as finish.
 - 3. Top Coat: Waterborne Flat Dryfall: P&L Industrial Waterborne Flat Dryfall Z5900
 - 4. Flat: MPI gloss level 1; use this sheen at all locations.
- B. Paint WI-OP-3L - Wood, Opaque, Institutional Low-Odor/VOC Latex System MPI INT 6.4R, 3 Coat:
 - 1. Prime Coat: Primer Latex, for interior wood, MPI #39.
 - 2. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - 3. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143 and Latex, interior, institutional low odor/VOC, eggshell (Gloss Level 2), MPI #144.
- C. Paint CI-OP-3L - Concrete/Masonry, Opaque, Latex, 3 Coat:
 - 1. One coat of block filler, latex, interior/exterior, MPI #4.
 - 2. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - 3. Topcoat: Latex, interior, institutional low odor/VOC, eggshell (MPI Level 2), MPI #144.
- D. Paint MI-OP-2A - Ferrous Metals, Primed, Alkyd, 2 Coat:
 - 1. Touch-up with alkyd primer.
 - 2. Semi-gloss: Two coats of alkyd enamel; P&L Pro-Hide Gold Interior Alkyd Semi-Gloss S889xseries.
- E. Paint Mgl-OP-3A - Galvanized Metals, Water-based light industrial coating over waterbourne primer system MPI INT 5.3K, 3 Coat:
 - 1. Prime Coat: Latex, fire-retardant, matching topcoat.
 - 2. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - 3. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss level 5), MPI #153.
- F. Paint GI-OP-3L - Gypsum Board/Plaster, Latex, 3 Coat:
 - 1. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
 - 2. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - 3. Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143; Latex, interior, institutional low odor/VOC, (Gloss Level 2), MPI #144 and Latex, interior, institutional low odor/VOC, gloss (MPI Gloss Level 6), MPI #148.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide all primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials required to achieve the finishes specified whether specifically indicated or not; commercial quality.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin application of coatings until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. Test shop-applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Gypsum Wallboard: 12 percent.
 - 2. Masonry, Concrete, and Concrete Unit Masonry: 12 percent.
 - 3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to coating application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Concrete and Unit Masonry Surfaces to be Painted: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- G. Gypsum Board Surfaces to be Painted: Fill minor defects with filler compound. Spot prime defects after repair.
- H. Galvanized Surfaces to be Painted: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- I. Corroded Steel and Iron Surfaces to be Painted: Prepare using at least SSPC-SP 2 (hand tool cleaning) or SSPC-SP 3 (power tool cleaning) followed by SSPC-SP 1 (solvent cleaning).
- J. Uncorroded Uncoated Steel and Iron Surfaces to be Painted: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by hand wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Prime paint entire surface; spot prime after repairs.
- K. Shop-Primed Steel Surfaces to be Finish Painted: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's instructions.
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance.

- E. Sand metal surfaces lightly between coats to achieve required finish.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.05 PROTECTION

- A. Protect finished coatings until completion of project.
- B. Touch-up damaged coatings after Substantial Completion.

END OF SECTION

**SECTION 101100
VISUAL DISPLAY UNITS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Markerboards
- B. Tackboards
- C. Tackable wall panels

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Blocking and supports.
- B. Section 09 2116 - Gypsum Board Assemblies: Concealed supports in metal stud walls.

1.03 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2018.
- C. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics; 2020.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data on chalkboard, markerboard, tackboard, tackboard surface covering, trim, and accessories.
- C. Shop Drawings: Indicate wall elevations, dimensions, joint locations , special anchor details.
- D. Samples: Submit color charts for selection of color and texture of markerboard, tackboard, tackboard surface covering, and trim.
- E. Manufacturer's printed installation instructions.
- F. Maintenance Data: Include data on regular cleaning, stain removal .

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Visual Display Boards:
 - 1. MooreCo, Inc: www.moorecoinc.com.
 - 2. Claridge Products and Equipment, Inc: www.claridgeproducts.com.
 - 3. Polyvision Corporation (Nelson Adams): www.polyvision.com.
 - 4. Substitutions: See Section 016000 - Product Requirements.

2.02 VISUAL DISPLAY BOARDS

- A. Markerboards: Porcelain enamel on steel, laminated to core.
 - 1. Color: White.
 - 2. Steel Face Sheet Thickness: 24 gage, 0.0239 inch .
 - 3. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
 - 4. Backing: Aluminum foil, laminated to core.
 - 5. Size: As indicated on drawings.

- 6. Frame: Extruded aluminum , with concealed fasteners.
 - 7. Frame Finish: Anodized, natural.
 - 8. Accessories: Provide chalk tray, map rail, and tack strip.
- B. Tackboards: Fabric laminated to cork.
- 1. Cork Thickness: 1/8 inch.
 - 2. Fabric: Vinyl coated fabric.
 - 3. Color: As selected from manufacturer's full range.
 - 4. Size: As indicated on drawings.
 - 5. Frame: Extruded aluminum , with concealed fasteners.
 - 6. Frame Finish: Anodized, natural.

2.03 MATERIALS

- A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
- B. Vinyl Coated Fabric: ASTM F793 Category VI.
- C. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.
- D. Foil Backing: Aluminum foil sheet, 0.005 inch thick.

2.04 ACCESSORIES

- A. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1 inch wide overall , full width of frame.
- B. Temporary Protective Cover: Sheet polyethylene, 8 mil thick.
- C. Chalk Tray: Aluminum, manufacturer's standard profile, one piece full length of chalkboard, molded ends, concealed fasteners, same finish as frame.
- D. Mounting Brackets: Concealed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

3.02 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions.
- B. Secure units level and plumb.

3.03 CLEANING

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Cover with protective cover, taped to frame.
- C. Remove temporary protective cover at Date of Substantial Completion.

SECTION 101400 SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Room and door signs.
- B. Dimensional letter signs.

1.02 REFERENCE STANDARDS

1.03 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, overall dimensions of each sign.
- C. Signage Schedule: Provide information sufficient to completely define each sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - 1. When room numbers to appear on signs differ from those on the drawings, include the drawing room number on schedule.
 - 2. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - 3. Submit for approval by Owner through Architect prior to fabrication.
- D. Samples: Submit two samples of each type of sign, of size similar to that required for project, illustrating sign style, font, and method of attachment.
- E. Selection Samples: Where colors are not specified, submit two sets of color selection charts or chips.
- F. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
- G. Manufacturer's Qualification Statement.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.06 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Flat Signs: Basis of Design: 2/90 Signs.
 - 1. Best Sign Systems, Inc: www.bestsigns.com/#sle.
 - 2. Cosco Industries (ADA signs): www.coscoarchitecturalsigns.com/#sle.
 - 3. Inpro: www.inprocorp.com.
 - 4. Substitutions: See Section 016000 - Product Requirements.

- B. Dimensional Letter Signs:
 - 1. A.R.K. Ramos Architectural Signage Systems; Cast Aluminum Letters: www.arkramos.com/#sle.
 - 2. Cosco Industries; Cast Aluminum: www.coscoarchitecturalsigns.com/#sle.
 - 3. FASTSIGNS: www.fastsigns.com/#sle.
 - 4. Inpro: www.inprocorp.com.
 - 5. Substitutions: See Section 016000 - Product Requirements.

2.02 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
 - 1. See Door Signage Types on Drawing Sheet A600.
 - 2. Sign Type: Flat signs with engraved panel media as specified.
 - 3. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
 - 4. Character Height: 1 inch.
 - 5. Sign Height: 2 inches, unless otherwise indicated.
 - 6. Office Doors: Identify with room numbers to be determined later, not the numbers shown on the drawings ; in addition, provide "window" section for replaceable occupant name.
 - 7. Conference and Meeting Rooms: Identify with room numbers to be determined later, not the numbers shown on the drawings; in addition, provide "window" section with sliding "In Use/Vacant" indicator.
 - 8. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
 - 9. Provide blank back panels for signs mounted to glass.

2.03 SIGN TYPES

- A. Flat Signs: Signage media in aluminum frame.
 - 1. Corners: Square.
 - 2. Frame Finish: Natural (clear) anodized.
 - 3. Wall Mounting of One-Sided Signs: Tape adhesive.
- B. Color and Font: Unless otherwise indicated:
 - 1. Character Font: Helvetica, Arial, or other sans serif font.
 - 2. Character Case: Upper case only.
 - 3. Background Color: To be selected from manufacturers full range of colors.
 - 4. Character Color: Contrasting color.

2.04 TACTILE SIGNAGE MEDIA

- A. Applied Character Panels: Acrylic plastic base, with applied acrylic plastic letters and braille.
 - 1. Total Thickness: 1/8 inch.
 - 2. Letter Thickness: 1/8 inch.
 - 3. Letter Edges: Square.

2.05 DIMENSIONAL LETTERS

- A. Metal Letters: Backlit
 - 1. Metal: Aluminum casting.
 - 2. Metal Thickness: 1/8 inch minimum.
 - 3. Letter Height: As indicated on drawings.
 - 4. Letter Depth: 2 inches.
 - 5. Text and Typeface:
 - a. Character Font: TBD.
 - 6. Finish: Brushed, satin.

7. Backlit: LED halo effect backlighting with a lexan back.
8. Mounting: Concealed screws.

2.06 ACCESSORIES

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
- B. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs where indicated:
 1. Room and Door Signs: Locate on wall at latch side of door with centerline of sign at 60 inches above finished floor.
 2. If no location is indicated obtain Owner's instructions.
- D. Protect from damage until Substantial Completion; repair or replace damage items.

**SECTION 102113.19
PLASTIC TOILET COMPARTMENTS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Solid plastic toilet compartments.
- B. Urinal screens.

1.02 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
- C. Product Data: Provide data on panel construction, hardware, and accessories.
- D. Samples: Submit two samples of partition panels, 2 by 2 inch in size illustrating panel finish, color, and sheen.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Solid Plastic Toilet Compartments: Basis of Design: Hiny Hiders by Scranton Products
 - 1. Ampco Products, Inc: www.ampco.com/#sle.
 - 2. Metpar Corp: www.metpar.com/#sle.
 - 3. Partition Systems International of South Carolina; PolyLife HDPE Toilet Partitions: www.psisc.com/#sle.
 - 4. Bradmar by Bradley Corporation.
 - 5. Substitutions: Section 016000 - Product Requirements.

2.02 PLASTIC TOILET COMPARTMENTS

- A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid molded high density polyethylene (HDPE), floor-mounted headrail-braced.
 - 1. Color: To be selected from manufacturers standard range.
- B. Doors:
 - 1. Thickness: 1 inch.
 - 2. Width: 24 inch. Out swinging
 - 3. Width for Handicapped Use: 36 inch, out-swinging.
 - 4. Height: 66 inch.
- C. Panels:
 - 1. Thickness: 1 inch.
 - 2. Height: 96 inch.
 - 3. Depth: As indicated on drawings.
- D. Pilasters:
 - 1. Thickness: 1 inch.
 - 2. Width: As required to fit space; minimum 3 inch.
- E. Screens: Without doors; to match compartments; mounted to wall with two panel brackets.

2.03 ACCESSORIES

- A. Pilaster Shoes: Formed chromed steel with polished finish, 3 in high, concealing ceiling fastenings.
 - 1. Provide ceiling attachment using two adjustable hanging studs, attached to above-ceiling framing.
- B. Head Rails: Extruded aluminum, anti-grip profile.
- C. Pilaster Brackets: Polished stainless steel.
- D. Wall Brackets: Continuous type, polished stainless steel.
- E. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.
 - 1. For attaching panels and pilasters to brackets: Through-bolts and nuts ; tamper proof.
- F. Hardware: Natural anodized aluminum:
 - 1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
 - 2. Door Latch: Slide type with exterior emergency access feature.
 - 3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
 - 4. Coat hook with rubber bumper; one per compartment, mounted on door.
 - 5. Provide door pull for outswinging doors.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
- E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch.
- B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

**SECTION 102600
WALL AND DOOR PROTECTION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Corner guards.

1.02 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Indicate physical dimensions, features, and anchorage details.
- C. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
- D. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in conformance with manufacturer's recommendations for each type of item.
- B. Store products in either horizontal or vertical position, in conformance with manufacturer's instructions.

1.04 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.
- C. Provide five year manufacturer and installer warranty for metal crash rails.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Corner Guards: Basis of Design: Inpro 150 High Impact.
 - 1. Babcock-Davis: www.babcockdavis.com/#sle.
 - 2. Construction Specialties, Inc: www.c-sgroup.com/#sle.
 - 3. Koroseal Interior Products: www.koroseal.com/#sle.
 - 4. Nystrom, Inc: www.nystrom.com/#sle.

2.02 PRODUCT TYPES

- A. Corner Guards - Surface Mounted:
 - 1. Material: High impact vinyl with full height extruded aluminum retainer.
 - 2. Performance: Resist lateral impact force of 100 lbs at any point without damage or permanent set.
 - 3. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - 4. Width of Wings: 3 inches.
 - 5. Corner: Radiused.
 - 6. Color: As selected from manufacturer's standard colors.
 - 7. Length: One piece.
 - 8. Preformed end caps.

2.03 FABRICATION

- A. Fabricate components with tight joints, corners and seams.

- B. Pre-drill holes for attachment.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces for adhered items are clean and smooth.
 - 1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.
- B. Position corner guard 4 inches above finished floor to 48 inches high.

3.03 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch.

3.04 CLEANING

- A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION

**SECTION 102800
TOILET, BATH, AND LAUNDRY ACCESSORIES**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Commercial shower and bath accessories.
- C. Utility room accessories.
- D. Grab bars.

1.02 RELATED REQUIREMENTS

- A. Section 088300 - Mirrors: Other mirrors.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- C. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2022.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- E. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- F. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- G. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror; 2024.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement and concealed ceiling supports to receive anchor attachments.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.
- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Toilet Accessories:
 - 1. AJW Architectural Products: www.ajw.com/#sle.
 - 2. ASI - American Specialties, Inc: www.americanspecialties.com/#sle.
 - 3. Bradley Corporation: www.bradleycorp.com/#sle.
 - 4. Bobrick Washroom Equipment, Inc..
 - 5. Substitutions: Section 016000 - Product Requirements.
- B. All items of each type to be made by the same manufacturer.

2.02 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
- B. Stainless Steel Sheet: ASTM A666, Type 304.

- C. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
- D. Galvanized Sheet Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- E. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- F. Adhesive: Two component epoxy type, waterproof.
- G. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

2.03 FINISHES

- A. Stainless Steel: No. 4 Brushed finish, unless otherwise noted.
- B. Chrome/Nickel Plating: ASTM B456, SC 2, satin finish, unless otherwise noted.
- C. Galvanizing for Items Other than Sheet: Comply with ASTM A123/A123M; galvanize ferrous metal and fastening devices.

2.04 TOILET ROOM ACCESSORIES

- A. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
 - 1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
 - a. Frame: 0.05 inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
 - b. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.
 - c. Products:
 - 1) Bobrick B-165.
- B. Grab Bars: Stainless steel, nonslip grasping surface finish.
 - 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force, minimum.
 - b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
 - c. Length and Configuration: As indicated on drawings.
 - d. Products:
 - 1) Substitutions: Section 016000 - Product Requirements.
- C. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
 - 1. Products:
 - a. Bobrick B-254.
 - b. Substitutions: Section 016000 - Product Requirements.
- D. Robe Hook: Stainless steel, surface-mounted, Bright-polished stainless steel. Flange is 2" x 2" (50 x 50mm). Projects 3 3/8" (85mm) from wall..
 - 1. Products:
 - a. Bobrick B-677.
 - b. Substitutions: Section 016000 - Product Requirements.

2.05 COMMERCIAL SHOWER AND BATH ACCESSORIES

- A. Shower Curtain Rod: Stainless steel tube, 1 inch outside diameter, 0.04 inch wall thickness, satin-finished, with 3 inch outside diameter, minimum 0.04 inch thick satin-finished stainless steel flanges, for installation with exposed fasteners.
- B. Shower Curtain:
 - 1. Material: Opaque vinyl, 0.008 inch thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
 - 2. Material: Waffle knit, machine washable, and mildew-resistant.

3. Size: 80 inches, hemmed edges.
4. Grommets: Stainless steel; pierced through top hem on 6 inch centers.
5. Color: White.
6. Shower Curtain Hooks: Chrome-plated or stainless steel spring wire designed for snap closure.

2.06 UTILITY ROOM ACCESSORIES

- A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
 1. Drying rod: Stainless steel, 1/4 inch diameter.
 2. Hooks: Two, 0.06 inch stainless steel rag hooks at shelf front.
 3. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
 4. Length: 36 inches.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.
- D. Verify that field measurements are as indicated on drawings.

3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
 1. Grab Bars: As indicated on the drawings.
 2. Mirrors: 3' 4" inch, measured to bottom of mirrored surface.
 3. Other Accessories: As indicated on the drawings.

3.04 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 105113 METAL LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal lockers.
- B. Locker benches.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Wood blocking and nailers.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's published data on locker construction, sizes, and accessories.
- C. Shop Drawings: Indicate locker plan layout, numbering plan.
- D. Samples: Submit two samples 3 by 6 inches in size showing color and finish of metal locker material.
- E. Manufacturer's Installation Instructions: Indicate component installation assembly.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Lockers: Basis of Design: Hadrian Athletic Gladiator
 1. Art Metal Products: www.artmetalproducts.com/#sle.
 2. ASI Storage Solutions: www.asi-storage.com/#sle.
 3. DeBourgh Manufacturing Co; Apex Series Lockers: www.debourgh.com/#sle.
 4. Lyon Workspace Products: www.lyonworkspace.com/#sle.
 5. Republic Storage Systems Co: www.republicstorage.com/#sle.
 6. Spacesaver Corporation: www.spacesaver.com/#sle.
 7. Substitutions: See Section 016000 - Product Requirements.

2.02 LOCKER APPLICATIONS

- A. Athletic Lockers: Metal lockers, free-standing with matching closed base.
 1. Width: 15 inch.
 2. Depth: 24 inches.
 3. Height: 72 inches.
 4. Configuration: Two tier.
 5. Fittings: Size and configuration as indicated on drawings.
 - a. Hooks: Two double prong.
 6. Ventilation: Perforated side panels and doors.
 7. Locking: Padlock hasps, for padlocks provided by Owner.
 8. Provide sloped top.
 9. Color: To be selected from manufacturer's full range by Architect.

2.03 METAL LOCKERS

- A. Locker Case Construction:
 - 1. Standard-Duty, _____ Construction: Made of formed sheet steel; metal edges finished smooth without burrs; powder coat finished inside and out.
 - a. Locker Body Components: Formed and flanged from steel sheet of the following type and minimum thicknesses:
 - 1) _____ Steel Sheet: Commercial Steel (CS), Type B, supplied for exposed applications and complying with ASTM A1008/A1008M and the following:
 - 2) Body and Shelves: 16 gauge, 0.0598 inch.
 - 3) Backs: 18 gauge, 0.0478 inch.
 - b. Frames: Formed channel shape, welded and ground flush, welded to body, resilient gaskets and latching for quiet operation.
 - 1) Door Frame: 16 gauge, 0.0598 inch, minimum.
 - c. Where ends or sides are exposed, provide flush panel closures.
 - d. Provide filler strips where indicated, securely attached to lockers.
 - B. Doors: Double-pan; welded construction, manufacturer's standard stiffeners, grind and finish edges smooth.
 - 1. Door Thickness: 16 gauge, 0.0598 inch, minimum.
 - 2. Form recess for operating handle and locking device.
 - C. Latches and Door Handles: Manufacturer's standard.
 - D. Cup, Pocket: Manufacturer's standard, with integral pull, and recessed surface punched for installation of lock, latch lift mechanism, and number plate.
 - E. Hinges: Heavy-duty, 5-knuckle type; two for doors under 42 inches high; three for doors over 42 inches high.
 - F. Sloped Top: 20 gauge, 0.0359 inch, with closed ends.
 - G. Trim: 20 gauge, 0.0359 inch.
 - H. Coat Hooks: Stainless steel or zinc-plated steel.
 - I. Number Plates: Provide rectangular shaped plastic plates. Form numbers 7/16 inch high of block font style with ADA designation, in contrasting color.

2.04 LOCKER BENCHES

- A. Locker Benches: Stationary type; bench top of laminated birch; painted steel pedestals.
 - 1. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 2. Products:
 - a. Salsbury Industries.
 - b. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared bases are in correct position and configuration.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Place and secure on prepared base.
- C. Install lockers plumb and square.
- D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds.
- E. Bolt adjoining locker units together to provide rigid installation.
- F. Install end panels and filler panels.

- G. Install fittings if not factory installed.
- H. Replace components that do not operate smoothly.

3.03 CLEANING

- A. Clean locker interiors and exterior surfaces.

END OF SECTION

**SECTION 105126
PLASTIC LOCKERS**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Solid plastic lockers.
- B. Locker benches.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Wood base construction.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- C. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's published data on locker construction, sizes and accessories.
- C. Shop Drawings: Indicate locker plan layout, numbering plan and combination lock code.
- D. Samples: Submit two samples 6 by 6 inches in size, of each color scheduled.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect locker finish and adjacent surfaces from damage.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Solid Plastic Lockers: Basis of Design: Scranton Products; Tufftec Lockers: www.scrantonproducts.com/#sle.
 - 1. Columbia Lockers, a division of PSiSC: www.psis.com/#sle.
 - 2. List Industries, Inc: www.listindustries.com/#sle.
 - 3. Substitutions: See Section 016000 - Product Requirements.

2.02 LOCKER APPLICATIONS

- A. Wardrobe Lockers: Solid plastic lockers, wall mounted for base indicated on drawings.
 - 1. Width: 18 inches.
 - 2. Depth: 24 inches.
 - 3. Height: 60 inches.
 - 4. Locker Configuration: Two tier.
 - 5. Fittings: Size and configuration as indicated on drawings.
 - a. Hooks: Two double prong.
 - 6. Ventilation: By horizontal slots at the top and bottom of door.
 - 7. Locking: Padlock hasps, for padlocks provided by Owner.
- B. Locker Benches: Free standing type; bench top of solid high density polyethylene (HDPE); aluminum pedestal pedestals.
- C. Locker Bench Support Brackets: Welded structural aluminum single arm floor mount pedestal bench support brackets; pre-drilled for bench top material attachment and for wall anchorage.
 - 1. Accessibility: Comply with ICC A117.1 and ADA Standards.
 - 2. Load Capacity per Bracket: 400 pounds.
 - 3. Finish: As selected by architect from manufacturer's available options.

2.03 SOLID PLASTIC LOCKERS

- A. Accessibility: Comply with ICC A117.1 and ADA Standards.
- B. Lockers: Factory assembled, made of solid plastic panels, tested in accordance with NFPA 286, homogenous color throughout.
 - 1. Doors: Fully overlay without frame, or framed.
 - 2. Locker Body Construction: Manufacturer's standard for selected product.
 - 3. Where locker ends or sides are exposed, provide same finish as fronts or provide extra panels to match fronts.
 - 4. Color: To be selected by Architect.
- C. Component Thicknesses:
 - 1. Doors: 1/2 inch minimum thickness.
 - 2. Locker Body: Tops, bottoms, backs, and shelves 3/8 inch minimum.
 - 3. End Panels and Filler Panels: 1/2 inch minimum thickness.
 - 4. Sloped Tops: 1/2 inch minimum thickness.
 - 5. Toe Kick Plates: 1 inch minimum thickness.
- D. Hinges: Full height of locker, manufacturer's standard heavy duty type.
- E. Coat Hooks: High impact plastic.
- F. Number Plates: Provide rectangular shaped aluminum plates. Form numbers 1 inch high of block font style with ADA designation, in contrasting color.
- G. Locks: Locker manufacturer's standard type indicated above.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared bases are in correct position and configuration.
- B. Verify bases and embedded anchors are properly sized.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Place and secure on prepared base.
- C. Install lockers plumb and square.
- D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 pounds.
- E. Install end panels, filler panels, and sloped tops.
- F. Install fittings if not factory installed.
- G. Replace components that do not operate smoothly.

3.03 CLEANING

- A. Clean locker interiors and exterior surfaces.

END OF SECTION

**SECTION 116623
GYMNASIUM EQUIPMENT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall mounted protection pads.
- B. Wrestling mats.

1.02 RELATED REQUIREMENTS

1.03 REFERENCE STANDARDS

- A. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- C. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Large Components: Ensure that large components can be moved into final position without damage to other construction.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data showing configuration, sizes, materials, finishes, hardware, and accessories; include:
 - 1. Fire rating certifications.
 - 2. Manufacturer's installation instructions.
- C. Shop Drawings: For custom fabricated equipment indicate, in large scale detail, construction methods; method of attachment or installation; type and gage of metal, hardware, and fittings; plan front elevation; elevations and dimensions; minimum one cross section; utility requirements as to types, sizes, and locations.
- D. Samples: Submit samples of wall pad coverings in manufacturer's available range of colors.
- E. Operating and maintenance data, for each operating equipment item.
- F. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified with minimum three years of experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in manufacturer's original packaging with factory original labels attached.
- B. Store products indoors and elevated above floor; prevent warping, twisting, or sagging.
- C. Store products in accordance with manufacturer's instructions; protect from extremes of weather, temperature, moisture, and other damage.

1.08 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Gymnasium Equipment:
 - 1. Draper, Inc: www.draperinc.com/#sle.
 - 2. Performance Sports Systems: www.perfsports.com/#sle.
 - 3. Porter Athletic Equipment Company: www.porterathletic.com/#sle.
 - 4. Substitutions: See Section 016000 - Product Requirements.

2.02 GENERAL REQUIREMENTS

- A. See drawings for sizes and locations, unless noted otherwise.
- B. Provide mounting plates, brackets, and anchors of sufficient size and strength to securely attach equipment to building structure; comply with requirements of contract documents.
- C. Hardware: Heavy duty steel hardware, as recommended by manufacturer.

2.03 WRESTLING MATS

- A. Wrestling Mats: ASTM-compliant foam core with reinforced vinyl.
 - 1. Surface Burning Characteristics: Flame spread index (FSI) of 25 or less, smoke developed index (SDI) of 450 or less, Class A, when tested in accordance with ASTM E84 as a complete panel.
 - 2. Size: Modular; See Drawings.
 - 3. Thickness: 1-1/4".
 - 4. Connection: Zip connection system.
 - 5. Color: Multi-color as selected from the manufacturer's full range of colors.
 - 6. Custom Graphics: digital files to be supplied by Owner.
 - 7. Products: Basis of Design: Resilite Flex3 Zip Wrestling Mat.
 - a. Substitutions: See Section 016000 - Product Requirements.

2.04 WALL PADDING

- A. Wall Padding: Foam filling bonded to backing board, wrapped in covering; each panel fabricated in one piece.
 - 1. Surface Burning Characteristics: Flame spread index (FSI) of 25 or less, smoke developed index (SDI) of 450 or less, Class A, when tested in accordance with ASTM E84 as a complete panel.
 - 2. Covering: Vinyl-coated polyester fabric, mildew and rot resistant; stapled to back of board.
 - a. Color: Two color as selected from the manufacturer's full range of colors.
 - b. Texture: Embossed leather-look.
 - c. Custom Graphics: digital files to be supplied by Owner.
 - d. Fabric Weight: 14 oz/sq yd.
 - 3. Foam: Urethane, soft, 3.5 pcf nominal density.
 - 4. Foam Thickness: 1-1/2 inches.
 - 5. Backing Board: Oriented strand board.
 - a. Thickness: 7/16 inch.
 - 6. Mounting: Removable; Z-clips fixed to wall and to padding.
 - 7. Products: Basis of Design: Resilite Wainscot Wall Padding.
 - a. Draper, Inc: www.draperinc.com/#sle.
 - b. IPI by Bison, Inc: www.ipibybison.com/#sle.
 - c. Performance Sports Systems Model 4110.
 - d. Substitutions: See Section 016000 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Take field measurements to ensure proper fitting of work. If taking field measurements before

fabrication will delay work, allow for adjustments within recommended tolerances.

- B. Inspect areas and conditions before installation. Notify Architect in writing of unsatisfactory or detrimental conditions. Do not proceed until conditions have been corrected. Commencing installation constitutes acceptance of work site conditions.
- C. Do not proceed with this work until conditions have been corrected; commencing installation constitutes acceptance of work site conditions.
- D. Verify that electrical services are correctly located and of the proper characteristics.

3.02 INSTALLATION

- A. Install in accordance with contract documents and manufacturer's instructions.
- B. Install equipment rigid, straight, plumb, and level.
- C. Secure all equipment with manufacturer's recommended anchoring devices.
- D. Install wall padding securely, with edges tight to wall and without wrinkles in fabric covering.
- E. Separate dissimilar metals to prevent electrolytic corrosion.

3.03 ADJUSTING

- A. Verify proper placement of equipment.
- B. Verify proper placement of equipment anchors and sleeves. Use actual movable equipment to be anchored if available.

3.04 CLEANING

- A. Remove masking or protective covering from finished surfaces.
- B. Clean equipment in accordance with manufacturer's recommendations.

3.05 PROTECTION

- A. Protect installed products until Date of Substantial Completion.
- B. Replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 122400 WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Window shades and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 061000 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.
- B. Section 092116 - Gypsum Board Assemblies: Substrate for window shade systems.

1.03 REFERENCE STANDARDS

- A. ASTM D4674 - Standard Practice for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Office Environments; 2019.
- B. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).
- C. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.
- D. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of all affected installers.
- B. Sequencing:
 - 1. Do not fabricate shades until field dimensions for each opening have been taken.
 - 2. Do not install shades until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
- C. Shop Drawings: Include shade schedule indicating size, location and keys to details.
- D. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.
- E. Selection Samples: Include fabric samples in full range of available colors and patterns.
- F. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.
- H. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of this type with minimum five years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each

opening.

- B. Handle and store shades in accordance with manufacturer's recommendations.

1.08 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.09 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
 - 1. Shade Hardware: 25 years.
 - 2. Fabric: 25 years.
 - 3. Aluminum and Steel Coatings: One year.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Manually operated and motorized roller shades shall be provided from the same manufacturer.
 - 1. Manually Operated Roller Shades: Basis of Design: Inpro WT
 - a. Draper, Inc: www.draperinc.com/#sle.
 - b. Lutron Electronics Co., Inc: www.lutron.com/#sle.
 - c. Levolor: www.levolor.com/commercial/#sle.
 - d. Hunter Douglas: www.hunterdouglas.com.
 - e. SWFcontract, a division of Springs Window Fashions, LLC.: www.swfcontract.com/#sle.
 - f. Substitutions: See Section 016000 - Product Requirements.

2.02 WINDOW SHADE APPLICATIONS

- A. ShadesWT-1: Inpro WT.
 - 1. Type: CF200 SoloMount Cordless.
 - 2. Fabric: Mesh; 90-Black, 3%.
 - 3. Mounting: Inside (between jambs).
 - 4. Operation: Manual.

2.03 ROLLER SHADES

- A. Roller Shades: Fabric roller shades complete with mounting brackets, roller tubes, hembars, hardware and accessories; fully factory-assembled.
 - 1. Drop: Regular roll.
 - 2. Size: As indicated on drawings.
- B. Fabric: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation; PVC-free; 100 percent recycled.
 - 1. Privacy Shades: Soften the light yet still reveal some details to the outside; moderate privacy; Openness Factor approximately equal to 1 percent.
 - 2. Blackout Shades: Block virtually all the light; Openness Factor equal to zero (0).
 - 3. Flammability: Pass NFPA 701 large and small tests.
 - 4. Fungal Resistance: No growth when tested according to ASTM G21.
- C. Roller Tube: As required for type of operation, extruded aluminum with end caps.
 - 1. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge.
 - 2. Finish: Baked enamel; color from manufacturer's standards.
- D. Hembars and Hembar Pockets: Wall thickness designed for weight requirements and adaptation to uneven surfaces, to maintain bottom of shade straight and flat.
- E. Manual Operation: Clutch operated continuous loop; beaded ball chain.

2.04 ACCESSORIES

- A. Fascias: Size as required to conceal shade mounting.
 - 1. Style: As selected by Architect from shade manufacturer's full selection.
- B. Brackets and Mounting Hardware: As recommended by manufacturer for mounting configuration and span indicated.
- C. Fasteners: Non-corrosive, and as recommended by shade manufacturer.

2.05 FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
- B. Fabricate shades to fit openings within specified tolerances.
 - 1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window stool.
 - 2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.
- C. Dimensional Tolerances: As recommended in writing by manufacturer.
- D. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine finished openings for deficiencies that may preclude satisfactory installation.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

- A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
- B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Installation Tolerances:
 - 1. Maximum Offset From Level: 1/16 inch.
- C. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
- D. Adjust level, projection and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.

3.05 PROTECTION

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 123600 COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Countertops for architectural cabinet work.
- B. Wall-hung counters and vanity tops.
- C. Sinks molded into countertops.

1.02 RELATED REQUIREMENTS

- A. Section 064100 - Architectural Wood Casework.

1.03 REFERENCE STANDARDS

- A. ANSI A161.2 - Performance Standards for Fabricated High Pressure Decorative Laminate Countertops; 1998.
- B. ANSI A208.1 - American National Standard for Particleboard; 2022.
- C. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023c.
- E. IAPMO Z124 - Plastic Plumbing Fixtures; 2022, with Editorial Revision.
- F. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- G. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- H. PS 1 - Structural Plywood; 2023.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation ; combine with shop drawings of cabinets and casework specified in other sections.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
- E. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- F. Installation Instructions: Manufacturer's installation instructions and recommendations.
- G. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Same fabricator as for cabinets on which tops are to be installed.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS

- A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Countertops: High-pressure decorative laminate (HPDL) sheet bonded to substrate.
 - 1. Laminate Sheet: NEMA LD 3, Grade HGS, 0.048 inch nominal thickness.
 - a. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - b. Finish: Matte or suede, gloss rating of 5 to 20.
 - c. Surface Color and Pattern: As indicated on drawings.
 - d. Manufacturers:
 - 1) Basis of Design: Formica & Wilsonart
 - 2) Substitutions: See Section 016000 - Product Requirements.
 - 2. Exposed Edge Treatment: Square, substrate built up to minimum 1-1/4 inch thick; covered with matching laminate.
 - 3. Back and End Splashes: Same material, same construction.
- C. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting over continuous substrate.
 - 1. Flat Sheet Thickness: 1/2 inch, minimum.
 - 2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Manufacturers:
 - 1) Wilsonart: www.wilsonart.com/#sle.
 - 2) Substitutions: See Section 016000 - Product Requirements.
 - b. Sinks and Bowls: Integral castings; minimum 3/4 inch wall thickness; comply with IAPMO Z124.
 - c. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
 - d. Color and Pattern: As indicated on drawings.
 - 3. Other Components Thickness: 3/4 inch, minimum.
 - 4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge; use marine edge at sinks.
 - 5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
 - 6. Skirts: As indicated on drawings.
- D. Natural Quartz and Resin Composite Countertops: Sheet or slab of natural quartz and plastic resin self-supporting over structural members.
 - 1. Flat Sheet Thickness: 1-1/4 inch, minimum.
 - 2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Manufacturers:
 - 1) Formica.
 - 2) Substitutions: See Section 016000 - Product Requirements.
 - b. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with the MIA Dimension Stone Design Manual.
 - c. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - d. Finish on Exposed Surfaces: Polished.
 - e. Color and Pattern: As indicated on drawings.

3. Other Components Thickness: 3/4 inch, minimum.
4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge.
5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
6. Skirts: As indicated on drawings.
7. Fabricate in accordance with manufacturer's standard requirements.

2.02 MATERIALS

- A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.
- B. Particleboard for Supporting Substrate: ANSI A208.1 Grade 2-M-2, 45 pcf minimum density; minimum 3/4 inch thick; join lengths using metal splines.
- C. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

2.03 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 1. Join lengths of tops using best method recommended by manufacturer.
 2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 2. Height: 4 inches, unless otherwise indicated.
- C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B. Attach plastic laminate countertops using screws with minimum penetration into substrate board of 5/8 inch.
- C. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

- A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.
- B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.

C. Field Joints: 1/8 inch wide, maximum.

3.05 CLEANING

A. Clean countertops surfaces thoroughly.

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

Table of Contents

Division	Section Title	Pages
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DIVISION 21 – FIRE PROTECTION

21 1000	Fire Suppression Systems	10
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DIVISION 22 – PLUMBING

22 0500	General Plumbing Requirements	6
22 0510	Basic Plumbing Materials and Methods	6
22 0700	Plumbing Systems Insulation	4
22 4000	Plumbing	5

DIVISION 23 – HEATING, VENTILATION AND AIR CONDITIONING

23 0500	General HVAC Requirements	7
23 0510	Basic HVAC Materials and Methods	4
23 0593	Testing Adjusting and Balancing	4
23 0700	HVAC Systems Insulation	6
23 0900	Controls and Control Sequences	12
23 2113	Hydronic Piping Systems	14
23 2123	HVAC Hydronic Pumps	4
23 7000	Ventilation and Air Conditioning	13

FIRE PROTECTION WORK SHALL INCLUDE:

SECTION 21 1000

PLUMBING & HYDRONICS WORK SHALL INCLUDE:

SECTION 22 4000, 23 2113, & 23 2123

& SECTIONS 22 0500, 22 0510, 22 0700, 23 0500, 23 0510, 23 0593, 23 0700, & 23 0900 AS APPLIES

VENTILATION AND AIR CONDITIONING WORK SHALL INCLUDE:

SECTION 23 0593, 23 0900 & 23 7000

& SECTIONS 23 0500, 23 0510, & 23 0700 AS APPLIES

SECTION 21 1000
FIRE SUPPRESSION SYSTEMS

PART 1 GENERAL

1.01 DEFINITIONS

- A. Contractor – Defined as the Contractor, Subcontractor and/or Subcontractors which are responsible for all or any part of the fire suppression system installation specified in Division 21 and/or as shown on the Contract Drawings.
- B. Wet Pipe Sprinkler System – A system in which automatic sprinklers are attached to piping filled with water allowing water to discharge immediately from sprinklers when activated. Sprinklers activate when heat bursts a frangible glass bulb or melts a fusible link. System activation or incidental flow is monitored by flow switches and/or alarm valves. Hose connections are included when required by code.

1.02 SCOPE

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 shall apply to this section.
- B. Where any requirements specified on the plans conflict with the specifications of this section, the specifications indicated on the plans shall govern.
- C. The Contractor shall provide all items, articles, materials, operations or methods listed, mentioned or scheduled on the Drawings and/or herein specified, including all labor, materials, equipment, accessories, wiring and incidentals necessary to be installed in accordance with manufacturer's recommendations except as otherwise approved.
- D. The fire protection system shall be a wet-pipe system consisting of 2 zones to protect the building addition as part of base bid and the entire facility as part of Alternate #5 as defined by the plans. The system in office, corridor, classroom, gymnasium areas shall be designed for light hazardous classification. The storage, mechanical, and electrical areas shall be designed for ordinary hazard, group 1 classification. The wrestling and stage areas shall be designed for ordinary hazard, group 2 classification as defined by the plans. Provide coverage for all concealed combustible spaces not filled with insulation.
- E. System(s) will be supplied by an 6" underground combined fire sprinkler service located in MEP/BOH 510A as part of base bid.
- F. The system(s) shall be complete with, but not limited to, sprinklers, piping, valves, alarm bell/horn, fire department connection, backflow preventer test connection, and controls necessary for a complete system.
- G. See the plans for water supply flow test information.

1.03 CONTRACTOR QUALIFICATIONS

- A. The Contractor for the fire protection installation shall be a qualified Fire Protection Contractor licensed in the State of North Dakota that has been regularly engaged in the installation of similar Automatic Fire Sprinkler Systems and associated fire protection equipment for a minimum of 5 years.

1.04 PERMITS AND SERVICE CHARGES

- A. All permits and service charges necessary for execution of the work under this Contract shall be obtained by and paid for by the Contractor. It shall be the responsibility of the Contractor to determine the permit requirements of the local authorities and utility companies and the cost of required permits, service charges, tap fees and development fees shall be included in the Contractor's bid.
- B. All work shall be executed in accordance with all local, state and national rules, regulations, codes, etc., which are applicable and shall be subject to inspection by the proper authorities.

1.05 CODES AND STANDARDS

- A. All work performed and all equipment furnished under this Division of the Contract shall be manufactured and installed in strict accordance with the most recent editions of all applicable codes and standards, including the applicable provisions of the following codes and standards:
 - 1. Local and State Codes, Standards and Regulations
 - 2. National Fire Protection Association (NFPA)
 - a. NFPA 13 –Installation of Sprinkler Systems
 - b. NFPA 25 – Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems
 - c. NFPA 72 – National Fire Alarm and Signaling Code
 - 3. National Electric Code (NEC) (NFPA 70)
 - 4. International Fire Code (IFC)
 - 5. Underwriter's Laboratory (UL)
 - 6. Uniform Plumbing Code
 - 7. International Mechanical Code
 - 8. American Waterworks Association (AWWA)
 - 9. Williams-Steiger Occupational Safety and Health Act of 1970 (OSHA)
 - 10. International Building Code
 - 11. Americans with Disabilities Act (ADA)
- B. Where specific requirements of any code vary with the requirements of another code, the higher standard as determined by the Architect/Engineer shall govern the installation.
- C. All equipment manufactured in accordance with the provisions of the above codes and standards shall bear the label of the respective association bureau thereon.
- D. All materials installed shall have composite fire and smoke hazard ratings as tested by procedures ASTM 84, NFPA 255 and UL 723 not to exceed 25 Flame Spread and 50 Smoke Developed.

1.06 AUTHORITIES AND AGENCIES

- A. All work will be installed for the approval and acceptance of the following:
 - 1. Ellendale Fire Marshal
 - 2. NE State Fire Marshals Office
 - 3. Fire Protection Engineer

1.07 DRAWINGS

- A. In general, the Drawings of the fire protection systems and equipment are to scale. However, to determine exact locations of walls and partitions, the Contractor shall consult the architectural and/or structural drawings which are dimensioned. Drawings shall not take precedence over field measurements.
- B. Drawings of piping and sprinklers, although shown on scale drawings, are diagrammatic only. They are intended to indicate size and/or capacity where stipulated, approximate location and/or direction, and approximate general arrangement of one phase of work to another, but not the exact detail or exact arrangement of construction. If it is found, before installation of any or all construction phases, that a more convenient, suitable or workable arrangement of any or all phases of the project would result by varying or altering the arrangement indicated on the Drawings, the Architect/Engineer may require the Contractor to change the location or arrangement of the work without additional cost to the Owner. Such rearrangement shall be in accordance with directions from the Architect/Engineer.
- C. Where discrepancies are discovered after certain portions or phases of the work have been installed, the Architect/Engineer reserves the right to require the Contractor to make changes in pipe, duct, fixture or equipment locations or arrangements to avoid conflicts with work at no additional cost to the Owner.
- D. Because the Drawings are to a relatively small scale to show as large a portion as is practical, the fact that only certain features of the system are indicated does not mean that other similar

or different features or details will not be required. The Contractor shall furnish all incidental labor, material or equipment for the systems so that each system is a complete and operating one unless otherwise specifically stipulated in the detailed body of the specifications.

- E. The Contractor, Subcontractor's and their respective trades shall cooperate in laying out their work so it will fit properly into the space provided. Promptly report to the Architect/Engineer any delay or difficulties encountered in the installation of this work which might prevent prompt and proper installation, or make it unsuitable to connect with or receive the work of others. Failure to so report shall constitute an acceptance of the work of other trades as being fit and proper for the execution of this work.

1.08 SHOP DRAWINGS

- A. Shop drawings to be submitted in electronic PDF format unless indicated otherwise in the General Conditions.
- B. To the extent practical, complete sets of shop drawings for each specification section shall be submitted. In the case that a particular item is required to be expedited, that particular item may be submitted individually.
- C. Submit shop drawings in electronic PDF format.
- D. Furnish Shop Drawings as follows:
 - 1. For all major items of equipment or materials, regardless of whether the item is to be furnished as specified.
 - 2. For all equipment, systems or devices where Shop Drawings are specifically called for.
 - 3. For all minor items of equipment or materials where the Contractor proposes to deviate from the specified and/or scheduled manufacturer or material.
- E. Shop Drawings will be reviewed by the Architect/Engineer, a review letter will be returned to the Contractor. Shop Drawings shall be submitted sufficiently in advance of the construction schedule to allow time for checking Drawings, resubmittal and rechecking when necessary.
- F. Shop Drawings will be reviewed by the Architect/Engineer, and copies of Shop Drawings will be returned to the Contractor. Shop Drawings shall be submitted sufficiently in advance of the construction schedule to allow time for checking Drawings, resubmittal and rechecking when necessary.
- G. Any equipment or material which is installed without authorization by properly processed Shop Drawings will be subject to removal by the Contractor and reinstallation as directed, without cost to the Owner. All cost for repair for damages as may be incurred to the structure as a result of the above correction shall be paid by this Contractor.
- H. Shop drawing material quantities will not be checked by the Architect/Engineer, and review of Shop Drawings by the Architect/Engineer shall not be construed to be verification of the material quantities and sizes shown on the Shop Drawings. Quantities, sizes, dimensions and locations shown on the Drawings and as specified shall determine material requirements.
- I. Hydraulic calculations proving the system is capable of providing the required design densities to accommodate the use and occupancy of each shall be performed by the contractor. The contractor is required to perform and submit hydraulic calculations as part of their submittal packages.

1.09 COORDINATION

- A. The Contractor shall communicate with all other Contractors on this project and shall arrange his work in proper relation to the work of others. Work made necessary as a result of failure to coordinate with other Contractors shall be the responsibility of this contractor and shall first be approved by the Architect/Engineer. The contractor shall coordinate with the General Contractor to maximize the efficiency of the onsite placement and to ensure the safe delivery and storage of the materials.

1.10 EXISTING SERVICES

- A. The Contractor shall verify the exact location of all existing building services extended and/or relocated for this project. The Contractor shall also verify the exact location and take proper precautions to protect all services which may be encountered during construction.
- B. All active services which are encountered shall be protected, braced and supported where required for proper execution of the work and without interruption of the service if possible.
- C. All inactive services which are encountered shall be protected or removed as directed by the Architect/Engineer, Owner, Utility Company or Municipal Agency having jurisdiction. The service shall also be plugged or capped as directed.
- D. When active services must be temporarily interrupted, the interruption shall be scheduled at night or at such time as approved by the Owner or authority having jurisdiction and so as to cause the minimum of interference with establishing operating routine. Arrangements shall be made to work continuously including overtime if required, to assure that services will be interrupted only as long as actually required to complete necessary work.

1.11 CLEANING

- A. The Contractor and/or Subcontractors for the various phases of the work shall clear away all debris, surplus materials, etc., resulting from their work or operations, leaving the job and equipment furnished under any or all contracts in a clean first class condition.

1.12 PAINTING

- A. Painting of materials and equipment furnished shall be as described in DIVISION 9. Contractor shall refinish and restore to the original condition and appearance, all equipment which has sustained damage to the manufacturer's prime and finish coats of enamel or paint. Materials and workmanship shall be equal to the requirements described in DIVISION 9.
- B. Where sprinklers are installed on exposed piping and in other locations where sprinklers are susceptible to paint spray or over-spray, contractor shall cover sprinklers in preparation for painting.

1.13 ACCESS TO EQUIPMENT

- A. Access shall be provided to all motors, valves, controls, specialties, etc., for maintenance purposes. All access doors, access panels, removable sections, etc., required for access shall be provided. The location of the access openings relative to the equipment shall be coordinated to assure proper access to the equipment. The door shall maintain any ratings of the wall, ceiling, etc. that it penetrates.
- B. Access openings are required for valves and other devices requiring access and shall be provided in the housings, tanks, walls, ceilings, etc., under this portion of the Contract.

1.14 INSPECTIONS, TESTING, CERTIFICATES, & WARRANTY

- A. All inspections, examinations and tests required by the authorities and agencies specified shall be arranged and paid for by the Fire Protection Contractor as necessary, to obtain complete and final acceptance of the Fire Protection System per the requirements of NFPA 13 and any other applicable codes. The Contractor shall provide a minimum 1 year warranty on the system effective starting the day of final system acceptance and also at that time be required to provide instruction to the owner or his representative to acquaint that person thoroughly with all system equipment.
- B. After completion of the fire protection installation and at the start of the guarantee year, the Fire Protection Contractor shall execute and file five (5) copies of the "Contractor's Material and Test Certificate, Sprinkler systems - Water Spray Systems" with the Architect/Engineer.

1.15 RECORD DRAWINGS

- A. The Contractor shall keep a complete set of all drawings in the jobsite office for purpose of showing the installation of mechanical systems and equipment. This set of drawings shall be used for no other purpose. Where any equipment or system components are installed different from that shown on the Architect/Engineer's drawings, such differences shall be clearly and

neatly shown on this set of drawings using ink or indelible pencil. At the completion of the project, the record set of drawings shall be turned over to the Architect/Engineer and shall become his property. Record drawings may be inspected by the Architect/Engineer at site visits.

1.16 OPERATING INSTRUCTIONS

- A. The Contractor shall furnish the Owner two (2) sets of complete catalog data, manufacturer's literature and detailed manuals covering the operation and maintenance of all equipment specified under this Section. All such literature shall be bound in an amply sized three-ring binder and submitted to the Architect/Engineer for approval and for eventual transmittal to the Owner. The manual shall have a Table of Contents at the front of the manual. In addition to a hard copy of the operating instruction, provide an electronic copy in PDF format to the Owner.
- B. The Contractor shall also supervise the initial operation of all equipment and instruct the operator selected by the Owner in such operation as required to acquaint him thoroughly with the equipment.

PART 2 - PRODUCTS

2.01 PRODUCT OPTIONS

- A. Materials or equipment specified by name of manufacturer, brand, trade name or catalog reference, shall be furnished under the contract unless changed by Addenda or a Contract modification.
- B. Where two (2) or more materials are named, the choice of these shall be limited to the items named. Where the material or equipment named is followed by the phrase "or equal" the required function, dimension, appearance and quality to be met by any proposed substitute is all that is intended to be established.
- C. Proposed substitutions for any named items shall be submitted to the Fire Protection Engineer for approval. No substitution shall be made without the approval of the Fire Protection Engineer. Any proposed substitution requests shall be submitted at least 10 days prior to bid to the Architect/Engineer for approval. Bidders shall not rely upon substitutions made in any other manner.
- D. Should a proposed substitution wish to be made within 10 days of bid the Contractor shall attach his proposed substitution along with the appropriate add or deduct to the Contract amount, should the substitution be accepted. Substitutions proposed by the Contractor will not be considered in the award of the Contract.
- E. All products shall be new and listed for fire protection use and be rated in excess of the maximum expected pressure that will be present in the systems.

2.02 SPRINKLERS

- A. Except where designated otherwise on the drawings, sprinklers shall be as follows:
 - 1. Sprinklers shall be standard semi-recessed white-plated pendant type in all locations where piping is concealed above ceilings.
 - 2. Sprinklers shall be standard upright type where piping is installed exposed in storage, garage and other locations as indicated on the Drawings. Upright sprinklers shall be plain brass finish.
 - 3. Sidewall sprinklers, where permitted, shall be white-plated semi-recessed in finished rooms, plain brass elsewhere.
- B. Temperature rating of sprinklers shall be in accordance with requirements of approving authorities, as noted on the Drawings, and per the requirements of NFPA 13.
- C. Sprinklers shall be installed centered in square ceiling tile and in the narrow dimension of rectangular ceiling tile. In rectangular tiles sprinklers shall be centered or at the quarter points along the longer dimension of the tile.
- D. Sprinklers installed in areas where damage may occur, such as gymnasiums, shall have head guards and as otherwise designated on the drawings. Sprinklers installed at elevations below 7'-0" shall have head guards.

- E. Concealed brass sprinklers with flush white-plated concealer plate shall be installed where noted on the Drawings. Sprinklers shall be Tyco, Reliable, Victaulic, Viking, or equal.

2.03 ESCUTCHEONS

- A. Escutcheons shall be installed as designated on the drawings and shall be the same make as the sprinkler head that is used.
- B. Escutcheons shall be Tyco, Reliable, Victaulic, Viking, or equal.

2.04 PIPE AND PIPE FITTINGS

- A. Furnish and install where shown on the Drawings and required for a complete system, pipe and fittings of type and material for the various services as noted below.
- B. Piping not shown on the Drawings, which is obviously necessary for complete systems, shall be provided and shall be amply sized in accordance with applicable codes and standards.
- C. Wet fire sprinkler system (water-filled) and deluge system (open-type) piping shall be ASTM A-135 standard-weight, black, Schedule 40 with factory or field formed threaded ends for sizes up to 2 inch size. Fittings used on threaded end piping shall be ASME B16.3 Class 150, ductile iron threaded fittings with NPT threads that conform to ANSI B1.20.1. Wet fire sprinkler piping shall be ASTM A-135 Schedule 10, black with factory or field formed roll-grooved ends for sizes 1-1/4" and greater. Grooved fittings shall be standard or short radius ASTM A-536, Grade 65-45-12, ductile iron fittings with cut-grooved ends and non-lead orange enamel coated. Grooved couplings shall include ductile iron, ASTM A-536, Grade 65-45-12, housings with non-lead orange enamel coatings, ASTM A-449 and ASTM A-183 bolts and nuts, and Grade "E" EPDM Type A gaskets. Grooved pipe outlets shall be tee-let, ASTM A-53, ANSI B1.20.1 threaded or cut groove, factory welded outlet fittings. Field installed outlets shall be permitted to be mechanical "T", bolted, ASTM A-536, orange enamel coated ductile iron, with ANSI B1.20.1 threaded or cut groove outlets, Grade "E" EPDM gaskets, and ASTM A-449 and ASTM A-183 bolts and nuts.
- D. Dry fire sprinkler system (compressed air-filled) piping and drain piping shall be ASTM A-135 standard-weight, Schedule 40 with factory or field formed threaded ends for sizes up to 2 inch size. Fittings used on threaded end piping shall be ASME B16.3 Class 150 ductile iron threaded fittings with NPT threads that conform to ANSI B1.20.1. Dry fire sprinkler piping shall be ASTM A-135 Schedule 40 standard-weight with factory or field formed roll-grooved ends for sizes 1-1/4" and greater. Grooved fittings shall be standard or short radius ASTM A-536, Grade 65-45-12, ductile iron fittings with cut-grooved ends. Grooved couplings shall include ductile iron, ASTM A-536, Grade 65-45-12, housings, ASTM A-449 and ASTM A-183 bolts and nuts, and Grade "E" EPDM gaskets. Grooved pipe outlets shall be tee-let, ASTM A-53 ductile iron, and ANSI B1.20.1 threaded or cut groove factory welded outlet fittings. Factory or field installed outlets shall be permitted to be mechanical "T", bolted, ASTM A-536 ductile iron, ASTM A-153, with ANSI B1.20.1 threaded or cut groove outlets, Grade "E" EPDM gaskets, and ASTM A-449 and ASTM A-183 bolts and nuts.
- E. All piping that penetrates an exterior wall shall be galvanized Schedule 40 minimum.
- F. Plastic CPVC Schedule 80 piping and fittings are allowed for this installation where approved by its listing.
- G. Copper piping shall be installed where designated on the drawings and as per its listing. Copper piping shall be soldered when installed concealed and brazed when installed exposed. Piping shall be Type M Mueller, Cerro, or equal.
- H. Flexible piping is allowed for this project where approved by its listing.
- I. All wet and dry system grooved pipe fittings and couplings shall be Victaulic, Anvil Gruvlok, Tyco, Star or equal. Grooved pipe fittings and couplings shall be ductile iron with an orange enamel coating for wet systems. All components shall be supplied by one manufacturer. Pipe fittings and couplings shall be standard or short radius.

- J. All threaded fittings shall be black ductile iron for wet systems and where otherwise required by the drawings. All dry system threaded fittings shall be galvanized ductile iron. Threaded fittings shall be supplied by Tyco, Star, Anvil, or equal.
- K. All welded outlet fittings shall be Merit, Island, or equal.
- L. All flanged fittings shall be ductile iron per ASTM A536. Flanged fittings shall be Anvil, Star, or equal.
- M. Plastic CPVC fittings are allowed for this installation where approved by its listing.
- N. Copper fittings shall be installed where designated on the drawings and as per its listing.
- O. All pipe ends shall be smooth and burr free and cleaned of any loose debris or pipe hole cutouts prior to installation.

2.05 HANGERS AND ATTACHMENTS

- A. All piping 1/2" through 8" shall be hung through the use of galvanized ring style band hangers with a knurled swivel nut. Hangers, spacing, and rod diameters shall be per NFPA 13 requirements.
- B. 3/8" all thread rod shall be used to attach the ring to the structural attachment device for pipe sizes 1/2" through 4", 1/2" all thread rod shall be used for pipe sizes 6" through 8", and 5/8" all thread rod shall be used for pipe sizes 10" through 12".
- C. Rings shall be Tolco, Hilti, Anvil, or equal.
- D. Structural Attachments shall be Sammy, Tolco, Hilti, or equal.

2.06 FIRESTOPPING

- A. Firestopping materials shall be 3M, Hilti, MetaCaulk, Nelson or equal. Firestopping material shall have a rating resistance rating equal to or greater than the wall in the penetration exists that will be sealed with said firestopping.

2.07 WALL, FLOOR AND CEILING PLATES

- A. Furnish and install chrome-plated wall, floor and ceiling plates on all exposed pipes where they pass through walls, floors, or ceilings in finished areas. Finished areas shall be those areas which are painted or have special finishes within the room. The wall plates shall be a minimum of 3/32 inch thickness and shall have set screws or spring locks for clamping to the piping. Flush valves shall have set screw type wall plates. The plates shall be chrome-plated steel, cast iron or brass and shall set tight against the wall.

2.08 CONTROL VALVES

- A. All valves shall be new and listed for fire protection use.
- B. Furnish and install valves in piping where so indicated on the Drawings.
- C. Of the several manufacturers listed, the Contractor is to standardize on one make as much as practical but not to the extent of sacrificing quality listed. Valves shall be Tyco, Milwaukee, Victaulic, Ames, Watts, Wilkins, or equal.
- D. Butterfly valves shall be of the indicating type with two sets of factory installed internal supervisory switches. Valves shall be ductile iron conforming to ASTM A-395 with Grade EPDM "E" encapsulated rubber disc seals. Valves shall be Tyco, Victaulic, or Equal.
- E. Outside Screw and Yoke (OS&Y) gate valves shall be ductile iron, raised face with bolted bonnets. Valve shall be Kennedy, Mueller, Nibco, Watts, or equal.
- F. Ball Valves 1-1/2" and smaller shall be standard port, end entry valves with a brass valve body. The ball shall be chrome plated brass with a stainless steel stem. Valves shall be Watts, Nibco, Milwaukee, Victaulic, or equal.

2.09 RISER MANIFOLDS

- A. Riser manifolds shall be provided for each wet zone designated on the drawings. The manifold shall include a 300 psi water gauge, water flow alarm switch with paddle, Schedule 40 pipe body, ductile iron angle valve with site glass, and pressure relief valve.

- B. Riser manifolds shall be Tyco, Viking, Reliable, or equal.

2.10 AUTOMATIC AIR VENT

- A. Furnish and install an automatic air vent for each wet zone. Automatic air vent shall be located near a high point in the wet system that allows for the maximum amount of air removal from that system. Automatic air vent shall have a minimum connection size of ½" and a minimum pressure rating of 175 psi.
- B. The device shall meet the requirements of UL 2573.
- C. Automatic air vent shall be Tyco, Viking, Reliable, or equal.

2.11 WATER FLOW SWITCHES AND ALARMS

- A. Water flow switches for alarm bell/horn and tamper switches shall be furnished and installed by this Contractor. All required wiring shall be installed by the Electrical Contractor.
- B. Water flow and tamper switches shall be Potter.

2.12 EXTERNAL BACKFLOW PREVENTER TEST CONNECTION

- A. Furnish and install a Guardian Series 6900 or equal projecting outlet connection where shown on the Drawings. Wall plate shall read "BACKFLOW PREVENTER TEST CONNECTION." Finish shall be rough brass. Outlets shall be 2-1/2 inch size and inlet shall be 4 inch size.
- B. Connections shall have rough brass plugs and chains. Outlets shall be 36 inches above finished grade or as specified on the drawings. Threads for Fire Department connections shall be National Standard. Verify threads and plug type with the local Fire Department.
- C. External backflow preventer test connection shall be Guardian, Potter Roemer, Central, Elkhart, or equal.

2.13 FIRE DEPARTMENT CONNECTION

- A. Furnish and install a Guardian Series 6100 or equal projecting connection where shown on the Drawings. Wall plate shall read "AUTOMATIC SPRINKLER." Finish shall be rough brass. Inlets shall be 2-1/2 inch size and outlet shall be 4 inch size. Install an automatic ball drips between the connection and the check valve.
- B. Connections shall have rough brass plugs and chains. Locking Fire Department connection plugs shall be provided where required by the fire code official and where the responding fire department carries appropriate key wrenches for removal. Outlets shall be 36 inches above finished grade. Threads for Fire Department connections shall be National Standard. Verify threads and plug type with the local Fire Department.
- C. Fire department connection shall be Guardian, Potter Roemer, Central, Elkhart, or equal.

2.14 DOUBLE CHECK VALVE BACKFLOW PREVENTER

- A. Furnish and install an Ames Fire & Waterworks Colt Series C200 or equal double check backflow preventer where shown on the Drawings. The backflow preventer shall be a complete assembly including tight closing shut-off valves before and after the device and also be protected by a strainer. It shall be a complete assembly including four ball type test cocks.
- B. The device shall meet the requirements of A.S.S.E. standard 1015 and A.W.W.A. standard C506.
- C. Double check valve backflow preventer shall be Ames, Watts, Hersey, Conbraco, Febco, Wilkins or equal.

2.15 PRESSURE GAUGES

- A. Furnish and install U.S. Gauge Model 5105 or equal pressure gauges in pipelines and on equipment as indicated herein and/or where shown on the Drawings. Gauges shall have phosphor bronze bourdon tube with brass movement.
- B. Gauges shall be compound, pressure or vacuum as required with 4-1/2 inch diameter dial. Each gauge shall be complete with Trerice No. 872 pressure snubbers, and brass ball valves.

- C. The normal operating pressure of each gauge shall be 50-70 percent of full scale. The range of the scale shall be suitable for the application.
- D. The gauges shall be located and mounted such that they can be conveniently read by a person standing on the equipment room floor. Accuracy shall be Grade "A". Case shall be aluminum.
- E. Pressure gauges shall be U.S. Gauge, Trerice, Weksler, Ashcroft, Weiss or equal.

PART 3 - EXECUTION

3.01 PIPING CONNECTIONS

- A. Pipe connection shall be through the use of grooved couplings attached to roll or cut grooves on the piping, female threaded fittings screwed on to threaded end pipe, and flanged fittings with bolts, nuts and rubber gaskets. Mechanical joint couplings may be used only with the approval of the Fire Protection Engineer.

3.02 PIPE HANGERS, SUPPORTS AND ANCHORS

- A. Anchors and other attachments to the building structure shall be installed where designated and as detailed on the Drawings and specified herein and/or as required. The hangers shall adequately support the piping system. They shall be located near or at changes in piping direction and as otherwise required by NFPA 13. They shall provide vertical adjustment to maintain pitch required for proper drainage. They shall allow for expansion and contraction of the piping. Hangers shall bear directly on piping.
- B. Pipe hangers shall not be attached to the roof deck. Hangers shall be attached to the structure with beam clamps, beam attachment and brackets bolted to joists and beams, wood lag bolts, steel self tapping screws, and any other approved means of attachment that is rated to support five time the weight of the water filled pipe plus 250 lbs of additional load.
- C. Hanging from one pipe to another is prohibited.

3.03 PIPING INSTALLATION

- A. All pipes shall be round and straight, of required size. Cutting shall be done with proper tools and pipes shall be reamed to full size after cutting.
- B. Piping shall be properly enclosed, supported, guided, anchored, sway braced, connected, tested, cleaned and flushed out and shall be properly insulated and protected where required.
- C. All pipes shall be run with proper grade to provide for easy draining and in group runs where applicable and in a neat and orderly manner, to the satisfaction of the Architect/Engineer. Lines required to be enclosed in ceiling, chase ways or similar spaces shall be installed to permit such enclosure as intended. All pipe runs shall be carefully laid out and scheduled to avoid necessary interferences with other work. If shown, pipe sizes on the Drawings are nominal pipe sizes and not outside diameters.
- D. Pipes shall be run substantially as indicated on the Drawings. However, the Architect/Engineer reserves the right to require this Contractor to make changes in pipe locations where conflicts occur with other trades. Such changes shall be made without extra cost to the Owner.
- E. Piping shall be installed with ample provisions for expansion and contraction to prevent injury to the same and to the building construction. Such provision shall be made by means of piping offsets, changes in direction, expansion loops and/or suitable expansion joints. Suitable anchors and guides shall be provided to permit proper deflection and compression of offset loops and expansion joints. Expansion joints shall not be used in lieu of offsets, changes in direction or loops, except where specified and/or indicated on the Drawings or where otherwise obviously necessary.
- F. Exposed piping shall be installed in a sanitary manner for ease in cleaning. Pipe shall be cut and threaded to fit the installation. Wherever possible, rough-in exposed pipe connections at the wall rather than the floor for ease in cleaning.

3.04 SLEEVES

- A. Any pipe passing through building construction including walls, floors, roofs or masonry partitions or as noted on the Drawings shall be encompassed with sleeves. Piping passing through any fire rated barrier, walls, or floor shall be installed as follows:
1. Sleeves shall have an inside diameter 1/2 inch greater than the outside diameter of pipe passing through. All sleeves shall be fabricated from new Schedule 40 steel pipe material cut square and reamed.
 2. Sleeves shall be provided in all masonry partition walls including locations above suspended ceilings where masonry partition walls extend from floor slab to slab above. Sleeves shall be Schedule 40 steel pipe finishing flush with the wall surface.
 3. Sleeves through exterior building walls shall be Schedule 40 steel pipe with welded flange in the middle of the sleeve and ends finishing flush with finished surfaces. Space between pipe and sleeve shall be packed to provide a watertight joint.
 4. Sleeves through roof slabs and floor slabs in concealed locations shall be Schedule 40 galvanized steel or linear polyethylene. Concealed sleeves shall be considered as pipe sleeves in shafts, pipe chases and within walls and partitions.
 5. Sleeves through floor slabs in exposed areas shall be Schedule 40 steel pipe and sleeves shall extend 1/4 inch above the finished floor surface. For slabs in equipment rooms and in other wet areas, sleeves shall be Schedule 40 steel pipe and shall extend 2 inches above finished floor surface.
 6. Floor sleeves in membraned floors shall be furnished with flashing rings and clamps.
 7. All sleeves in exposed locations, except equipment rooms, shall be set so plates specified will cover the sleeves.
 8. All pipe sleeves where wet conditions exist, except sleeves through exterior walls, shall be caulked with a plastic caulking, including sleeves in concealed locations. The space between the pipe and the sleeves shall be caulked in both ends of sleeve, even with the ends of the sleeve. The sealer shall be suitable for temperatures from minus 50 degrees to 300 degrees, suitable for painting, non-corrosive and have good adhesion.
- B. Sleeves in fire rated construction, equipment rooms, and/or where designated on the Drawings shall consist of schedule 40 steel pipe. Seal sleeves with a fire retardant sealant. When applied according to manufacturer's recommendations, sealant shall have a 3-hour U.L. fire rating.
- C. All sleeves shall be set and maintained in place by this Contractor during the progress of the work. This Contractor shall be responsible for locating all sleeves at the proper location.
- D. Sleeves are not required for core drilled masonry wall and floor holes, masonry wall and floor holes formed by polyethylene plastic (removable) sleeves, or for masonry holes made in another neat manner except in equipment rooms and other wet areas.
- E. Sleeves are not required in metal or wood stud wall construction. Rated systems shall be provided as required to provide the necessary rating of the penetration.

3.05 DRAINS

- A. Drains shall be located and piped to discharge to the locations designated on the plans. Where required drains are not noted on the plans system drains shall be piped to a floor drain or mop sink where said drains or sinks are capable of accepting full system flow without excessive deflection of discharging water. Drain shall be piped through the wall of the building to atmosphere when a floor drain or mop sink is not available and where piping through the wall of the building to atmosphere is most convenient and has been approved by the Architect/Engineer.

END OF SECTION

**SECTION 22 0500
GENERAL PLUMBING REQUIREMENTS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The mechanical contractor shall perform all work and furnish all materials as indicated in the mechanical plans and specifications as necessary for the successful completion of this project.

1.3 PERMITS AND SERVICES

- A. The mechanical contractor shall obtain all permits and arrange all inspections, give notices and pay all fees as required by the Authority Having Jurisdiction.
- B. This contractor shall coordinate any necessary site utilities including water, natural gas, and sewer work with local utility, owner, and other contractors to minimize disruption and downtime. ANY AND ALL CHARGES ASSESSED BY THE UTILITY OR CITY TO ACCOMMODATE THE REQUIREMENTS OF THIS PROJECT ARE THE SOLE RESPONSIBILITY OF THE MECHANICAL CONTRACTOR. VERIFY ALL CHARGES AND COORDINATE ALL EQUIPMENT NECESSARY WITH THE UTILITY BEFORE SUBMITTING BID.

1.4 DRAWINGS AND MEASUREMENTS

- A. Verify all dimensions and conditions with Architectural and Structural drawings. The small scale of the drawings prohibits the indication of all offsets, fittings and accessories necessary and shall be furnished by this Contractor and required for complete and proper operation.
- B. "Existing Conditions" shown on drawings are based on existing plans and limited field investigation. The field survey was conducted to verify, as much as possible, the accuracy of the locations shown. The Contractor shall verify the accuracy of the "Existing Conditions" as shown on the drawings. As the demolition work progresses perform modifications and additions as necessary to correct for these hidden conditions and allow for the completion of the new work.
- C. The general arrangement of the mechanical systems shall be as shown on the drawings. Field changes shall have the written acceptance of the Engineer.
- D. Consult the drawings and specifications of all other trades. Layout work and coordinate with other trades, before installing any equipment, to avoid interfering with these trades or conflicting with applicable codes.
- E. The mechanical contractor shall bear full responsibility for coordinating his work with other trades to avoid conflicts in space requirements, clearances, etc. Problems arising due to lack of coordination will be the responsibility of the mechanical contractor to resolve. Extra work and/or equipment as a result of not coordinating work shall be the responsibility of the installing contractor and at no cost to the Owner.

1.5 INSPECTION OF SITE AND DOCUMENTS

- A. Before submitting a proposal on the work contemplated, the bidder shall thoroughly familiarize himself with the contract documents, the site, and all existing conditions and limitations that may affect the performance of his work. Any conflict noted shall be brought to the attention of the Engineer before bidding. If there is not sufficient time prior to bidding, the Contractor shall bid the larger quantity or better quality of work.
- B. No extra compensation will be allowed, because of misunderstanding the amount of work involved or the bidder's lack of knowledge, for obvious conflicts which could have been discovered or reasonably anticipated prior to bidding.

1.6 REGULATIONS AND CODES

- A. All work, materials, and equipment in this contract shall comply with all applicable local, city, state and federal ordinances, regulations, and codes.

1.7 INSTRUCTIONS

- A. Furnish verbal and engineer approved written instructions to Owner on all systems. Instruction shall include operating procedures, adjustments, and periodic maintenance. Furnish a copy of the written instructions and attach a letter to the Engineer, prior to final inspection, signed by Owner, attesting to date and satisfaction of instructions.

1.8 OPERATING AND MAINTENANCE MANUALS (3 Hard Copies & 1 Electronic Submittal via Submittal Exchange)

- A. PRIOR TO FINAL INSPECTION, The mechanical contractor shall furnish (3) hard copies (including 1 USB drive containing electronic copy) and (1) electronic submittal via Submittal Exchange of the O&M Manuals to the Engineer, containing all pertinent data to the mechanical systems. Information shall be indexed and labeled per system and shall include catalog cuts, installation manuals, maintenance manuals, manufacturer's names, replacement parts list. Include balancing reports as specified. Include written instructions and warranty info as specified.
- B. The first section shall be indexed/labeled "WRITTEN INSTRUCTIONS & TRAINING" noting written instructions with company service contact info and shall include a list of filters for each unit. Also include document with owners signature attesting to date and satisfaction of training.
- C. The second section shall be indexed/labeled "WARRANTY INFO" and shall include a statement of guarantee on the contractors company letter head and shall include warranty statements of all equipment provided/installed under his contract with specific dates. This will note any longer/special warranties.

1.9 AS-CONSTRUCTED DRAWINGS (Red Lined on Plans & USB Drive containing scanned PDF)

- A. During construction, each trade shall keep track of the major changes in the rerouting of piping and equipment, and shall note these in red on one set of drawings. This set of drawings shall be submitted with the Operation and Maintenance Manuals along with a USB drive containing a single PDF file with these same red line plans in electronic form. Most printing shops will be able to scan your trade's large plan sheets into electronic form. Contact the engineer's office if there are any questions.

1.10 WORKMANSHIP

- A. Qualified individuals that are properly licensed to perform the work involved shall perform all mechanical work.

1.11 CUTTING AND PATCHING

- A. This Contractor shall be responsible for all cutting and patching of holes required for passage of piping, equipment, and ducts. This also applies to the removal or installation of new equipment.
- B. All cutting of existing construction required to install or join new work, except where otherwise indicated on the plans, shall be the responsibility of this Contractor and coordinated with the Construction Manager. Before making any cuts, verify exact locations and sizes with the Construction Manager to confirm that no structural members will be cut. Contractor shall make every effort to minimize extent of cutting existing construction.
- C. The mechanical contractor shall be responsible for patching any openings left in floors, walls, and ceilings that were caused by his/her actions. Patching shall match existing surface in color, texture and quality so that patch is indistinguishable from original surface.

1.12 PAINTING

- A. Any equipment which becomes rusted or damaged during construction shall be repaired, cleaned, and repainted by this Contractor. Painting shall always be applied in two coats, one primer and one finish.

1.13 EQUIPMENT AND PIPE SUPPORTS

- A. Provide all structural supporting frames, steel stands, concrete bases, and hangers as required for mechanical equipment. All floor equipment shall be set on 4" high concrete bases furnished by this Contractor, unless otherwise noted.
- B. Paint all unprotected metal, except galvanized and copper, with metal protective paint.
- C. **Hangers for piping shall be large enough to encompass insulation. It shall not be acceptable for insulation to envelope hangers/saddles, or for insulation to stop on either side of hangers.**
- D. Provide saddles at all hangers or supports of insulated piping. Saddles for 4" and larger piping shall be fabricated of 14 gauge galvanized iron, and for smaller piping shall be fabricated of 16 gauge galvanized iron. Saddles shall be one-half the circumference of the pipe insulation and 4" shorter than the insulation inserts.
- E. Under no condition shall any pipe or duct structure be used to support another.

1.14 ACCESS TO EQUIPMENT

- A. Access shall be provided to all motors, valves, dampers, controls, specialties, etc., for maintenance purposes. All access doors, access panels, removable sections, etc., required for access shall be provided. The location of the access openings relative to the mechanical equipment shall be coordinated to assure proper access to the equipment.
- B. Access openings are required for manual, motorized, fire, and smoke dampers and other devices requiring access and shall be provided in the ductwork, plenums, housings, tanks, etc., under this portion of the contract.

1.15 EXCAVATING AND BACKFILLING

- A. When work to be completed by this contractor requires trenching, digging, etc. this contractor shall be responsible for properly protecting open trenches in accordance with required safety procedures. Backfill shall be placed in horizontal layers, not exceeding 9 inches in thickness. Moisten and hand or machine compact to 95% of standard proctor density. Bring fill to elevations indicated. If backfill fails the proctor density test in accordance with ASTM D-2049 and conducted by an independent testing laboratory retained by the owner, Contractor shall recompact and retest until satisfactory density is reached. This contractor shall restore the surface (whether grass, asphalt, concrete, etc.) to its original condition. Grass shall be seeded to match surrounding turf.
- B. When work is in public street, paving repairs shall be equal to and comply with municipal agency requirements. If repairs are done by municipal agency, make necessary arrangement with such agency to make the repairs. Contractor shall include cost for permits, inspection fees, work, etc. in Mechanical Bid.

1.16 TESTING AND ADJUSTING

- A. At the completion of work, all parts of the installation under Division 22 shall be cleaned, lubricated, tested, and adjusted for proper operation.
- B. All piping and ductwork shall be tested and cleaned as required, by all local, state and federal codes. Tests shall be performed in the presence of the authority having jurisdiction. Written notification of test, date, and results shall be furnished to the Engineer before concealing or covering the installation.
- C. All controls shall be tested and adjusted for proper operation. Adjustments shall be made when all systems are operating which may affect the control system.
- D. An Independent Testing & Balancing Agent shall test and balance all mechanical systems as specified in Section 23 0593.

1.17 GUARANTEE

- A. Warranty: The mechanical contractor shall warrant his work against failure and workmanship for a period of at least one year from the date of substantial completion, for all new work. Any work that is defective within that one-year period shall be replaced by the Contractor without

charge. If longer/special warranties are noted elsewhere in the specifications, those warranties shall apply.

1.18 EQUIPMENT IDENTIFICATION

- A. Major mechanical equipment, rooftop units, energy recovery ventilators, electric duct heaters, heat pumps, exhaust fans, etc. shall be provided with identification as designated on the plans. Labels shall be black laminate three-layer plastic with engraved 1/2 inch white letters, adhered, screwed, or riveted to the equipment. Manufactured by Brady, Champion America/Seton.
- B. Piping shall be identified as to contents and flow direction with plastic, color coded, snap-on or adhesive labels. Manufactured by Brady, Champion America/Seton.
 - 1. Labeling shall be located:
 - a. Adjacent to each valve.
 - b. At each side of and at each obstruction.
 - c. At each branch.
 - d. At each cap for future.
 - e. At each takeoff.
 - f. At each side of penetration of structure or enclosure.
 - g. At each equipment connection.
 - h. At all access doors.
 - i. A maximum of every 40 feet on straight runs of piping including rises and drops.
 - j. Minimum one label per room/space.
- C. Valve tags shall be brass with stamped letters, tag size 1-1/2" minimum in diameter.
 - 1. Provide typed valve lists in each O&M binder. Valve lists shall include the valve number, location, and purpose of each valve, and any other necessary information such as the required opening or closing of another valve when one valve is to be opened or closed.
- D. Color coded indicators shall be installed on the ceiling grid or access door to hard lid areas to indicate all valves and other ceiling mounted equipment requiring service (example – VAV's). Each trade shall be responsible for equipment provided under their respectable trade.
 - 1. Each ceiling label shall be color coded laminated engraved plastic, 1/16" thick, 2.5" wide by 0.75" tall, with white lettering centered on each label. Label to be adhered to the acoustic ceiling tile grid. Seton Style AV0175 or similar.

1.19 MECHANICAL SUBMITTAL

- A. All equipment shall be as listed on the equipment schedules or approved equal.
- B. Prior Approval: Manufacturers whose product is not specified or specifically listed on the plans or in the specifications are allowed to submit information on a product that they would like to be considered as an equal to those specified or listed. By submitting this information for consideration, the product representative is indicating that the product being presented for consideration equals or exceeds the specified product in quality, performance and operating parameters. Proof of equality rests with the party making the request. The procedure for this submittal is listed below.
- C. Submit literature on product that is to be considered for prior approval. This literature shall include catalog cuts with all pertinent technical specifications, dimensions and pictures of the product.
- D. Final approval of all equipment shall be contingent on shop drawing acceptance, compliance with the specifications and performance criteria as required. General approval to bid a product does not relieve the supplier or contractor of meeting specific specification requirements.
- E. The Mechanical Contractor shall pay, provide, install and be responsible for any extra materials required due to his use of alternate accepted equipment which has installation requirements different than the specified equipment. This includes paying other trades for any extra work they are involved in due to this substitution of equipment.
- F. Literature shall be submitted so that the engineer receives it no later than 7 days prior to bid date.

- G. All approvals will be in the form of an addendum issued to all plan holders.
- H. List of Acceptable Substitutions:
 - 1. Equipment Identification, Pipe Labeling, Valve Tags, Ceiling Grid Labeling: Seton, Brady Corporation, Marking Services Incorporated
 - 2. All Drains (Floor & Roof): Wade, Zurn, Smith, Josam, Ancon, Watts.
 - 3. Valves: Crane, Hammond, Watts, Rockwell, Milwaukee Valve Co., Mueller.
 - 4. Plumbing Fixtures: American Standard, Kohler, Crane, Elkay, Just, Zurn, Fiat Products, Gerber, Bradley, Stingray
 - 5. Fixture Brass: American Standard, Kohler, Zurn, Sloan, T & S Brass, Chicago, Bradley, Swan, Woodford Mfg.
 - 6. Flush Valves: Zurn AquaVantage, Sloan, American Standard
 - 7. Lav Premolded Insulation Kit: Plumberex, Truebro, Proflo
 - 8. Toilet Seats: Kohler, Church, Beneke, Bemis, Olsonite, Zurn, Proflo
 - 9. Electric Water Coolers: Elkay
 - 10. Domestic Water Heaters: Bock
 - 11. Domestic Expansion Tank: Bell & Gossett, Taco, Wessels, Watts, Armstrong, Thrush, Grundfos, Amtrol, American Wheatley, Elbi, Pentair
 - 12. Domestic Hot Water Circulation Pumps: Bell & Gossett, Taco, Grundfos, Armstrong
 - 13. Digital Water Tempering System: PVI, Powers, Watts, Lawler, Caleffi
 - 14. Thermostatic Mixing Valves Under Lavs: Lawler, Powers, Watts

1.20 SHOP DRAWINGS

- A. Before ordering any item, Contractor shall review, stamp with his approval and submit shop drawings of equipment as to be furnished under this contract.
 - 1. Electronic submittals are REQUIRED. Electronic submittals can be one combined .pdf. for each of the following mechanical trades: Fire Sprinkler Drawings, Fire Sprinkler Calcs, Fire Sprinkler Materials, Temperature Controls, HVAC, Plumbing, and Hydronics.
- B. Where the contractor is submitting shop drawings that differ from the plans and specifications, the contractor must notify the engineer in writing each variance from the plans and specifications and the Mechanical Contractor shall pay, provide, install and be responsible for any extra materials required due to his use of alternate accepted equipment which has installation requirements different than the specified equipment. This includes paying other trades for any extra work they are involved in due to this substitution of equipment.
- C. Product Data shall include, but are not limited to, the following: Manufacturer's product specifications, Manufacturer's installation instructions, standard color charts, catalog cuts, roughing-in diagrams and templates, and standard wiring diagrams.

1.21 TEMPORARY HEAT

- A. Temporary heating of the building during construction will be provided as specified in the General Conditions and Supplemental General Conditions. Under no circumstance shall the proposed HVAC equipment be brought into service as temporary heating prior to project completion without written permission from the mechanical engineer & owner.

1.22 EXECUTION

- A. Remove equipment as indicated. Demolition work shall be coordinated with the Owner. Should questions arise regarding the removal of equipment, confer with the owner before such equipment is demolished.
- B. Materials removed by demolition shall remain the property of the Owner unless specifically noted. Material the Owner does not wish to retain shall be removed and properly disposed of by the Contractor.
- C. The existing building will be in use during this construction. Schedule and carry out the work in such a manner as to cause the Owner a minimum of inconvenience due to service interruptions. Temporary services shall be installed if one area or phase of construction disrupts service to another area of the building or if equipment has to be relocated to allow construction to progress. Service interruptions shall be confined to the smallest area possible

at any one time and interruptions shall be scheduled with the Owners site representative. After service has been restored following an interruption, inspect areas affected by the interruption and be responsible for returning automatically controlled equipment to the same operating condition that existed prior to the interruption.

- D. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.
- E. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- F. Coordinate mechanical equipment and materials installation with other building components. Verify all dimensions by field measurements. Arrange for chases, slots, and openings in other building components to allow for mechanical installations.
- G. Final locations of equipment may differ slightly from those shown on these plans. Coordinate exact location of equipment with equipment supplier, structural members, furniture layout and other trades before rough in and adjust accordingly. Pricing shall allow for a minimum of 10 ft. of difference in the actual location of items as compared to the location shown on the drawings.
- H. All penetrations for piping, ductwork, etc. which penetrate floors, fire and/or smoke walls, roofs, full height partitions and similar structures shall be sealed by the mechanical contractor with a UL system specifically approved for the application. This system must maintain the required fire rating.
- I. All mechanical systems shall be tested and cleaned as required by Authority Having Jurisdiction.
- J. The mechanical contractor shall have the full responsibility of ensuring that his/her work is performed in a safe manner and shall bear all liability associated with his/her job site safety.
- K. Upon completion of the work, the Contractor shall notify the A/E and make arrangements for a final inspection. Contractor shall provide A/E with copy of all required balance reports prior to the final inspection.
- L. After the final inspection is made, the Contractor will receive a list of items requiring adjustment, correction, replacement, or completion.
- M. The Contractor shall comply completely with all listed requirements within (40) days of receipt of list. Should the Contractor fail to perform within this time limit, the A/E and/or Owner reserves the right to have the work completed by others and the cost deducted from the contract price.

END OF SECTION 22 0500

SECTION 22 0510
BASIC PLUMBING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section includes the following basic mechanical materials and methods to complement other Division 22 Sections.
 1. Piping materials and installation instructions common to most piping systems.
 2. Dielectric fittings.
 3. Mechanical sleeve seals.
 4. Sleeves.
 5. Escutcheons.
 6. Grout.
 7. Mechanical Demolition.
 8. Concrete bases.
 9. Installation requirements common to equipment specification sections.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 QUALITY ASSURANCE

- A. All piping shall be specified in this section. Material and installation shall also be subject to state, local codes and ordinances of the area encompassing this project.
- B. Welder's Qualifications: All welder shall be qualified in accordance with ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- C. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."
- D. Uninsulated plastic waste, vent and roof drain piping is not allowed above any ceiling in a return air plenum.
- E. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Provide piping and factory fabricated fittings as indicated for each service and pipe size. Fitting sizes and types shall match piping or equipment connections. Where not indicated, comply with governing regulations or manufacturer's recommendations.

2.2 WATER SERVICE OUTSIDE OF BUILDING

- A. Domestic water service below ground shall be ductile iron, bell and spigot. Ductile iron shall be Class 52 water pipe with mechanical joint fittings meeting AWWA Standard C153. Pipe and fittings shall be coated with asphaltum and internally cement lined.
- B. Furnish and install thrust blocks and/or tie-rods in accordance with the local water department standards and regulations.
- C. Provide a copy of the plot plan showing exact locations of all underground services direct to the engineer with accurate dimensions from the building such that all the underground service can be located.

2.3 WATER PIPING IN BUILDING UNDERGROUND

- A. Domestic water piping in building below ground shall be ductile iron. The ductile iron shall be AWWA ductile iron, bell and spigot, class B water pipe with fittings being Class D ductile iron AWWA bell and spigot coated with asphaltum and/or Class 150 C.I. mechanical joints, Federal Specification WW-P-421 with rubber gaskets.
- B. Furnish and install thrust blocks and/or tie-rods in accordance with the local water department standards and regulations.
- C. Provide a copy of the plot plan showing exact locations of all underground services direct to the engineer with accurate dimensions from the building such that all the underground service can be located.

2.4 SANITARY WASTE, VENTING, AND STORM DRAIN PIPING

- A. Below Grade: Extra heavy weight, coated cast iron soil pipe, hub-&-spigot, ASTM A 74, with TY-seal double seal, premolded one piece Neoprene compression type gasket, ASTM C 564, or lead/oakum joint materials, FSQQ-C-40.
 - 1. Service weight "No-Hub" cast iron soil pipe, FS WW-P-401, with Neoprene gasket, ASTM C564, and stainless steel drawband.
 - 2. Where permitted by plumbing and building codes, schedule 40 Polyvinyl Chloride sewer pipe (PVC), ASTM D 2729, with sewer fittings ASTM D 2729, and solvent cement, ASTM D 2564.
- B. Above Grade: Service weight cast iron soil pipe, Hub-&-Spigot, ASTM A 74, with premolded one piece Neoprene compression type gasket, ASTM C 564, or lead/oakum joint materials, FS QQ-C-40.
 - 1. Service weight "No-Hub" cast iron soil pipe, CISPI standard 301, or FS WW-P-401, with Neoprene gasket, ASTM C564, and stainless steel drawband, conforming to CISPI standard 310.
 - 2. Where permitted by plumbing and building codes, schedule 40 Polyvinyl Chloride (PVC), type DWV, ASTM D 2665; with schedule 40 DWV fittings, ASTM D 2665 and patterns conforming to ASTM D 3311. Solvent cement, ASTM D 3138.
- C. Provide a copy of the plot plan showing exact locations of all underground services direct to the engineer with accurate dimensions from the building such that all the underground service can be located.
- D. Before building footings are formed, this contractor shall start excavating for sewer services and shall confirm that depth of existing sewer is such that the building sewer services will drain into

it by gravity. If existing sewer is not deep enough, the contractor shall notify the engineer at once.

2.5 DOMESTIC WATER (COLD, HOT, & RECIRCULATING HOT WATER) IN BUILDING ABOVE GROUND

- A. Piping shall be Type "L" hard drawn copper water tube.
 - 1. Fittings wrought copper, solder joints. Joints 95-5 or lead free solder.
 - 2. Pressure-Seal-Joint fittings: wrought copper with EPDM O-ring seal in each end. Sizes NPS 2-1/3" and larger with stainless steel grip ring and EPDM o-ring seal. Minimum 200 psig working pressure rating at 250 F.
- B. Uponor PEX-A potable water piping system with Uponor expandable F1960 fittings (no crimp fittings to be accepted) provided the contractor is trained and following all manufacturer's recommendations thus fulfilling all available Uponor warranty coverage.
 - 1. PEX may only be used where concealed above ceilings or routed in raised floor. See plans.

2.6 FUEL OIL PIPING

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M, for butt and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
 - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Threaded or butt welding to match pipe.
 - c. Lapped Face: Not permitted underground.
 - d. Gasket Materials: Asbestos free, ASME B16.20 metallic, or ASME B16.21 nonmetallic, gaskets compatible with fuel oil.
 - e. Bolts and Nuts: ASME B18.2.1, cadmium-plated steel.
- B. Comply with ASME B31.9, "Building Services Piping," for fuel-oil piping materials, installation, testing, and inspecting.
- C. Fuel-Oil Valves: Comply with UL 842 and have service mark initials "WOG" permanently marked on valve body.
- D. Comply with requirements of the EPA and of state and local authorities having jurisdiction. Include recording of fuel-oil piping.
- E. SPECIALTY VALVES
 - 1. Oil Safety Valves:
 - a. Body: Brass, bronze, or cast steel.
 - b. Springs: Stainless steel.
 - c. Seat and Diaphragm: Nitrile rubber.
 - d. Orifice: Stainless steel, interchangeable.
 - e. Factory-Applied Finish: Baked enamel.
 - f. Manual override port.
 - g. Maximum Outlet Pressure: 3 psig
- F. VALVE INSTALLATION
 - 1. Install manual fuel-oil shutoff valves on branch connections to fuel-oil appliance.
 - 2. Install valves in accessible locations.
 - 3. Install oil safety valves at inlet of each oil-fired appliance.

2.7 DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- B. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.8 MECHANICAL SLEEVE SEALS

- A. Description: Modular design, with interlocking rubber links shaped to continuously fill annular space between pipe and sleeve. Include connecting bolts and pressure plates.

2.9 SLEEVES

- A. The following materials are for wall, floor, slab, and roof penetrations:
 - 1. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
 - 2. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
 - 3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
 - 4. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.10 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- C. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.

2.11 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.12 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION

- A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.
 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Do not run piping through electrical or electronic equipment spaces and enclosures unless unavoidable. Install drip pan under piping that must be run through electrical spaces, if approved by local authority.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping to permit valve servicing.
- H. Install piping to allow maximum possible headroom unless specific mounting heights or slopes are indicated.
- I. Install piping at indicated slopes, or level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.

- L. Install piping to allow application of insulation.
- M. Select system components with pressure rating equal to or greater than system operating pressure.
- N. Install escutcheons for penetrations of walls, ceilings, and floors.
- O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials conforming to the 25/50 flame spread and smoke developed rating.
- S. Verify final equipment locations for roughing-in.
- T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

END OF SECTION 22 0510

**SECTION 22 0700
PLUMBING SYSTEMS INSULATION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The work in this section of the specification and the accompanying drawings consists of performing all labor, equipment, accessories, and materials and in performing all operations necessary for the installation of all insulation for the plumbing, circulating hot water heating piping systems, and sealing of sleeves.
- B. Work to be insulated includes the following:
 - 1. All domestic cold water piping, valves, and fittings.
 - 2. All domestic hot & recirculating hot water piping, valves, and fittings.
 - 3. All roof drain bodies, vertical and horizontal storm drainage and rainleader piping completely down to connection at underground piping.
 - 4. All sleeves.
- C. All insulation work shall be installed in a workmanlike manner by skilled workmen engaged in this type of work.
- D. Fire-Test-Response Characteristics: Provide products with flame-spread and smoke-developed indices of 25 and 50, respectively, according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction.

1.3 SUBMITTALS

- A. Shop drawings/product data as specified in Section 22 0500 shall include the following:
 - 1. Product Data: Identify thermal conductivity, thickness, and jackets (both factory installed and field applied, if any), for each type of product indicated.

1.4 COORDINATION

- A. Coordinate clearance requirements with duct Installer for insulation application.
- B. Coordinate clearance requirements with piping Installer for insulation application.
- C. Coordinate size and location of supports, hangers, and insulation shields.
 - 1. All hangers and insulation shields for piping shall be large enough to encompass insulation without penetrating vapor barrier.
 - 2. It shall not be acceptable for insulation to envelope hangers/saddles.
 - 3. It shall not be acceptable for insulation to terminate on either side of hangers not properly sized to encompass insulation.

PART 2 - PRODUCTS

2.1 NEW DOMESTIC COLD, HOT, & RECIRCULATING WATER PIPING INSULATION

- A. All piping in concealed and exposed areas shall be insulated with fiberglass pipe insulation with all service jacket. Jacket shall be factory-applied, and, where specified, with white foil scrim-kraft vapor barrier. Insulation shall be Johns-Manville Micro-Lok 850 APT, or accepted equal.
- B. For pipe sizes 1" and less – insulation thickness shall be ½". For pipe sizes of 1-1/4"-2" – insulation thickness shall be 1". For pipe sizes of 2-1/2" and larger – insulation thickness shall be 1-1/2".
- C. Fittings, valves, flanges, etc. shall be insulated with fiberglass blanket, Johns-Manville Microlite or pre-cut mitered sections for elbows, J-M Micro-Lok (1lb/cu. ft. density).
- D. Encase pipe fitting insulation with one piece pre-molded PVC fitting covers having flame spread index of 25 or less, and smoke developed index of 50 or less, as tested by ASTM E84 (NFPA 255) method.

- E. Provide sheet metal insulation shields at all hanger locations.

2.2 NEW STORM PIPING AND ROOF DRAIN BODIES

- A. All piping in concealed and exposed areas shall be insulated with fiberglass pipe insulation with all service jacket. Jacket shall be factory-applied, and, where specified, with white foil scrim-kraft vapor barrier. Insulation shall be Johns-Manville Micro-Lok 850 HP, or accepted equal.
- B. For all pipe sizes and drain bodies – insulation thickness shall be 1" and be fully vapor sealed.
- C. Fittings, valves, flanges, etc. shall be insulated with fiberglass blanket, Johns-Manville Microlite or pre-cut mitered sections for elbows, J-M Micro-Lok (1lb/cu. ft. density).
- D. Encase pipe fitting insulation with one piece pre-molded Zeston 2000 PVC fitting covers having flame spread index of 25 or less, and smoke developed index of 50 or less, as tested by ASTM E84 (NFPA 255) method.
- E. Provide sheet metal insulation shields at all hanger locations.
- F. **Hangers for piping shall be large enough to encompass insulation. It shall not be acceptable for insulation to envelope hangers/saddles, or for insulation to stop on either side of hangers.**

PART 3 - EXECUTION

3.1 GENERAL APPLICATION

- A. All insulation shall be applied on clean, dry surfaces. All joints shall be snugly butted against the adjoining piece and all joints, seams, voids, flat spots, etc., shall be filled with insulation cement. Do not use cut pieces or scraps abutting each other.
- B. Where double layers are installed, the first layer shall be fastened with binding wire. All joints shall be staggered between the two layers.
- C. Insulation on all cold surfaces must be applied in a continuous, unbroken vapor seal. Hangers, supports, anchors, etc., that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation.
- D. All surface finishes shall be extended to protect all surfaces, ends, and raw edges of insulation.
- E. All insulation materials shall be installed in strict accordance with manufacturer's instructions, using recommended adhesives, mastics and coatings applied at specific coverage per gallon and temperature conditions.
- F. Extend insulation without interruption through walls, floors and similar penetrations, except where otherwise indicated.
- G. Maintain integrity of vapor-barrier jackets on insulation, and protect to prevent puncture or other damage.
- H. Do not apply insulation to equipment, breechings, or stacks while hot.
- I. Do not insulate boiler manholes, handholes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.
- J. Provide removable insulation sections to cover parts of equipment, which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.
- K. Repair damaged sections of existing mechanical insulation, both previously damaged or damaged during this construction period. Use insulation of same thickness as existing insulation, install new jacket lapping and sealed over existing.
- L. Insulation installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

3.2 MINERAL-FIBER PIPE INSULATION APPLICATION

- A. Fittings, valves, and flange insulation shall be wrapped firmly under compression (minimum 2:1) to a thickness equal to the adjoining insulation, secured with No. 20 gauge galvanized annealed

steel wire, and finished with a smoothing coat of mastic, Johns-Manville No. 375 Insulating and Finishing Cement or equal.

- B. Cold Fittings, Valves, Flanges, etc., shall be additionally sealed with a layer of resin coated glass mesh, such as Johns-Manville Duramesh 207 glass cloth, embedded between two 1/16" thick coats of vapor barrier coating, Benjamin Foster 30-35 or equal. Lap the sealed glass cloth at least 2" on itself and the adjoining insulation.
- C. Premolded Insulation Valve and Fitting Covers shall be installed by tack fastening, banding, or taping as required by manufacturer.
- D. Expansion Joints: For expansion joints, a tube of pipe insulation shall be fabricated that will allow the expansion joint to move within the tube. The insulating tube shall be fastened at one end of the pipe or equipment and the other end shall be free to slide over the adjacent insulated piping. Provide an aluminum jacket over the insulated pipe to provide a smooth surface on which the insulated tube may slide.
- E. Insulation Under Hangers: Pipe hangers shall encompass the insulation and shall have sheet metal saddles furnished by the Mechanical Contractor.
- F. Inserts shall be installed at all hanger locations. Inserts between the pipe and pipe hangers shall consist of 13lb/cubic foot hydrous calcium silicate pipe insulation, or wood blocking, of thickness equal to the adjoining insulation and shall be provided with vapor barriers where required. Insulation inserts shall not be less than the following lengths:
 - 1. 1/2" to 1-1/2" pipe size 10" long
 - 2. 3" to 6" pipe size 12" long
 - 3. 8" and larger pipe size 16" long
- G. On all piping the full thickness of insulation and jacket shall run continuously under the sheet metal pipe saddle and through the pipe hanger (pipe hanger shall be large enough to permit full insulation thickness.)

3.3 SEALING OF SLEEVES

- A. All sleeves for pipes, ductwork, etc., furnished under Division 22 of specifications, penetrating floors, fire and/or smoke walls and full height partitions, including chase walls, shall be sealed in accordance with the following:
 - 1. All insulated services shall have the specified insulation terminated on either side of sleeve. Services which require a vapor barrier jacket shall have segment through sleeve insulated with calcium silicate having a minimum thickness same as specified for service. Vapor barrier jacket shall be uninterrupted. Entire void space between inside of sleeve and outside of duct, pipe, and/or calcium silicate insulation shall be packed with fiber insulation, conforming to HHI-521E Type 3 or HHI-558B Form A and having an ASTM fire class E-84 with fiber melt point in excess of 2000 degrees F., to a point 1/8 inch from ends of pipe sleeve. After void is packed with fiber insulation, services which are specified to be insulated shall have a section of insulation installed on each side of sleeve, insulation to be fitted tight to sleeve insulation. Balance of space in sleeve to be filled with nonhardening silicone conforming to TTS-00230 and of type which will allow 50 percent movement in one direction.
 - 2. Contractor is herein given the option to provide Pipe Shield, Inc., fire rated wall and floor sleeves for insulated and noninsulated piping in lieu of sealing sleeves as outlined above. Shields shall be installed in strict accordance with manufacturer's recommendations.

END OF SECTION 22 0700

**SECTION 22 4000
PLUMBING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The work in this specification and the accompanying drawings consists of performing all labor and furnishing of all material and equipment necessary to install complete systems listed below, including minor items obviously necessary for complete and operating systems.
 - 1. Plumbing Fixtures
 - 2. Soil, Waste, Sanitary Drainage, and Vent Piping
 - 3. Storm Drainage System
 - 4. Fuel Oil Systems
- B. The plumbing work shall be installed in strict accordance with all applicable local, state, national plumbing regulations, and authority having jurisdiction.
- C. Also included is the work involved to remove existing associated equipment, remodeling of existing systems, including connections between new and existing systems.

1.3 SUBMITTALS

- A. Shop drawings as specified in Section 22 0500 shall include the following:
 - 1. Domestic Water/Fire Sprinkler Service Stub Out Piping
 - 2. Sanitary Sewer Service Stub Out Piping
 - 3. Domestic Water System Piping, Valves, and Fittings
 - 4. Dual Check Back Flow Prevention Assemblies
 - 5. City Utility Provided Water Meters
 - 6. Uponor Pex A Tubing & F1960 expandable fittings (if using)
 - 7. Sanitary Waste & Vent System Piping and Fittings
 - 8. Storm System Piping and Fittings
 - 9. Fuel Oil Filters, Piping, Fittings, and Oil Safety Valves
 - 10. Plumbing Fixtures
 - 11. Floor Drains
 - 12. Floor Sinks
 - 13. Interior Cleanouts
 - 14. Primary Roof Drains
 - 15. Shock Absorbers & Mfg'r's Recommended Locations to be Installed
 - 16. Digital Thermostatic Mixing Valve
 - 17. Oil Fired Domestic Water Heaters
 - 18. Domestic Hot Water Recirc Pump
 - 19. Domestic Water System Expansion Tank
 - 20. Domestic Hot Water Recirculation Manual Balancing Valves and Strainers
 - 21. Drain Valves with Chained Caps

PART 2 - PRODUCTS

2.1 GENERAL

- A. Before proceeding with this part of the work, the Contractor shall carefully survey the existing conditions, and, if necessary, modify the service installation, in order to avoid unforeseen obstructions such as in the floor ductwork, etc. This Contractor shall include all costs for this work, including saw cutting & patching, permits, etc., in his bid.

2.2 COMBINATION DOMESTIC WATER/FIRE SPRINKLER SERVICE STUB OUT

- A. Provide new water service stub out as indicated on the plans. Provide minimum 7'-0" of cover over water line outside of building. Install city provided water meter(s) as shown on the plans

and in accordance with the manufacturer's recommendations. Make all arrangements with Water Department and comply with all requirements. Include all costs and fees associated with meter and water service in bid. Purchase meter from city and install in accordance with water department requirements.

- B. Furnish and install sleeves, thrust blocks and/or tie-rods in accordance with the local water department standards and regulations.
- C. Provide & Install dual check back flow prevention assembly(s) suitable for continuous pressure application. Include shutoff valves on inlet and outlet, strainer on inlet, and test cocks with two positive seating check valves. Manufacturer and model shall be as specified on plans or approved equal.

2.3 SANITARY SEWER SERVICE

- A. Provide new sewer services as indicated on the plans. Provide minimum 5'-6" cover over sewer line outside of building. Provide main clean out where sewer leaves building as indicated on the plans. Before building footings are formed, this contractor shall start excavating for sewer services and shall confirm that depth of existing sewer is such that building sewer services will drain into it by gravity. If existing sewer is not deep enough, the contractor shall notify the Engineer at once.
- B. Before proceeding with this part of the work, the Contractor shall carefully survey the existing conditions, and, if necessary, modify the service installation, in order to avoid unforeseen obstructions, such as telephone cables, cisterns, electrical conduits, large tree roots, existing water and sewer lines, flag pole bases, etc. This Contractor shall include all costs for this work, including street and sidewalk repair, permits, etc., in his bid.

2.4 PLUMBING FIXTURES

- A. Furnish and install plumbing fixtures where shown on the Drawings. Type, size, and performance shall be as tabulated in the schedule and on the drawings.
- B. Where indicated on the drawings to be a future fixture, this contractor shall provide all waste, vent, and water supplies as indicated on the drawings and according to local code.
- C. Exposed flush, waste, and supply pipes at the fixtures shall be chromium plated brass pipe, iron pipe size. Fittings for brass pipe shall be cast brass, chromium plated.
- D. Install chromium plated wall or floor plates (escutcheons) with set-screw where piping passes through walls or floors.
- E. All handicap laboratories supply pipe and drain pipe will be fitted with removable safety covers that comply with handicap code requirements.
- F. All fixtures fitted to the walls or floors shall be ground and true and be sealed with a non-hardening white silicone caulk bead.
- G. All plumbing fixtures shall be supported per manufacturer's recommendations.

2.5 FLOOR DRAINS

- A. Furnish and install floor drains where shown on the Drawings. Type, size, and performance shall be as tabulated in the schedule and on the drawings. Connect outlet of drain to "P" trap. Venting installation requirements of floor drains whether or not shown on plans shall be according to code and approved by the code official.
- B. Furnish and install any floor drains required by the authority having jurisdiction to meet the Uniform Plumbing Code 2009 704.3.

2.6 FLOOR SINKS

- A. Furnish and Install floor sinks where shown on the Drawings. Type, size, and performance shall be as tabulated in the schedule and on the drawings. Connect outlet of drain to "P" trap. Venting installation requirements of floor sinks whether or not shown on plans shall be according to code and approved by the code official.

2.7 CLEANOUTS (INTERIOR)

- A. Furnish and install clean outs where shown on the Drawings. Type, size, and performance shall be as tabulated in the schedule and on the drawings. Install proper traffic rating and floor pattern shape for intended use.
- B. Cleanouts shall be provided at the base of all vertical stacks with the cleanout plug located approximately 12" above the floor and extended to wall access cover. Cleanouts in floors on grade shall be located as shown on plans and at changes in direction of pipe run and shall consist of Y fittings and eighth bends. Cleanouts must be provided in accordance with the local code and as shown on the drawings.
- C. Floor cleanouts – frame and cover threaded for 2" vertical adjustment, threads protected with shield to be removed when concrete is set. Covers-nickel bronze round frame and cover, deep flange tractor type. Extra heavy type in heavy traffic areas, and with carpet cleanout marker for carpeted floors.
- D. Wall Cleanouts – access covers shall be stainless steel.

2.8 PRIMARY ROOF DRAINS

- A. Furnish and install roof drains where shown on the Drawings. Type, size, and performance shall be as tabulated in the schedule and on the drawings
- B. Roof drains shall be cast iron body, cast iron dome, sump receiver, underdeck clamp, and no-hub outlet.
- C. Installation shall be as per manufacturer's recommendations.

2.9 ROOF JACKET

- A. Roof extension from soil, waste, and vent pipes shall be extended at least 18 inches above the roof, and must be encased in frostproof jackets, each having an air space at least 1" between the outside surface of the pipe and a cap over the top of the pipe so that it will be unnecessary otherwise to plug the inside of the vent pipes at the top when the test is made. These plugs must be of a type readily seen until removed. Remove them at once after the piping system has been tested and approved.

2.10 SHOCK ABSORBERS

- A. Piping shall be installed with proper safeguards to prevent water hammer. This will be done by installing a sufficient number of shock absorbers/water hammer arrestors. Shock absorbers shall be Watts or equal. Shock absorbers to be sized and located as per manufacturer's recommendations.
- B. Contractor to indicate installed locations on as-built drawings.

2.11 DIGITAL WATER TEMPERING SYSTEM

- A. Temperature control system shall be controlled digitally via integrated circuit board technology designed to deliver blended water economically at accurate temperature selected by user as safe and appropriate for sanitary use in facility's recirculated hot water system. The mixing valve shall be a Lawler Neptune EMX with model as noted on plans.
- B. Construction shall be lead free design and in compliance with lead free laws. Digital water temperature control and monitoring system shall feature interface capable of displaying critical system data in standard or metric measurements. Unit shall be user-configurable on location and shall not require factory pre-programming prior to shipment. Temperature adjustment shall be made locally by user at the control module and shall not require a laptop computer or special software to initiate. BAS to monitor and override.
- C. System shall control water temperature to +/- 2°F in accordance with ASSE 1017 and during periods of low and zero demand, and maintain a consistent system "idling" temperature to mitigate "temperature creep" without the use of a manual throttling device/balancing valve. The actuator shall be located external to mixing chamber where water from valve cannot affect performance as a result of faulty o-rings or seals.

- D. System shall digitally monitor and display the following without the use of a separate module, laptop and special software that must be downloaded:
- E. Mixed outlet temperature and mixed outlet set point in oF/oC
- F. Control module shall integrate with building automation systems through BACnet and/or Modbus protocols without the use of a separate module, and feature local and remote temperature alarms.
- G. In the event of a power failure, system will fail to "last position" in event of power failure. In the event of the loss of cold water, the system will close the hot water inlet. Actuator shall also feature a manual override which can be used to set mixed outlet temperature in the event of a power loss.
- H. System shall be listed/approved to ASSE 1017, cUPC, NSF and CSA 24/UL873. System shall come with a standard 5-year limited warranty.
- I. Provide & install unions or flanges as shown on piping detail to facilitate simple unit removal for maintenance.

2.12 FUEL OIL FILTERS AND SAFETY VALVES

- A. Provide filter(s) and oil fire safety valves as indicated on the Drawings.
 - 1. Oil fire safety valves shall be Firomatic fusible valves or equal.
- B. Install per International Mechanical Code, NFPA, and AHJ requirements.

2.13 OIL FIRED DOMESTIC WATER HEATERS

- A. Furnish and install water heaters where shown on the Drawings. Type, size, and performance shall be as tabulated in the schedule and on the drawings. Equip tank with ASME rated temperature pressure relief valve. Unit shall be UL listed and exceed the minimum efficiency requirements of ASHRAE/IES 90.1b-1992. Provide & install accessories as scheduled on the plans.
- B. Provide & install venting and combustion air ducting per manufacturer's requirements.
- C. Provide and install all accessories as scheduled.

2.14 DOMESTIC HOT WATER RECIRC PUMP

- A. The contractor shall furnish and install inline pump as illustrated on the plans and in accordance with the following specifications:
 - 1. The pump shall be of the horizontal, permanently lubricated type, specifically designed and guaranteed for quiet operation.
 - 2. The pump shall have a steel shaft supported by permanently lubricated, sealed precision ball bearings. The pumps are to be equipped with a water-tight seal to prevent leakage. Mechanical seal faces to be carbon on silicon carbide. The motor shall be non-overloading at any point on the pump performance curve.
 - 3. The motor shall be of the drip-proof, sealed precision ball-bearing, quiet-operating construction. The permanent split-capacitor motor shall be equipped with thermal overload protection.
 - 4. Pump to be suitable for 225°F (107°C) operating temperature at 150 psig (10 bar) working pressure.
 - 5. Variable speed EC motor.
 - 6. Stainless steel body & impeller construction for potable water application.

2.15 WATER SYSTEM EXPANSION TANK

- A. Furnish and install a pre-pressured expansion tank as scheduled on the drawings or prior approved equal.

2.16 DOMESTIC HOT WATER RECIRCULATION MANUAL BALANCING VALVES AND STRAINERS

- A. Calibrated Balance Valve
 - 1. Valve body shall be constructed out of lead free brass
 - 2. Valve shall include a ball valve constructed in 304 Stainless Steel.
 - 3. Valve shall be AB1953 and CSA certified and compliant with NSF/ANSI-372.

4. Valve body shall include two pressure/temperature ports.
 5. Valve body shall include an optional drain valve port.
 6. Valve shall utilize a calibrated nameplate with a memory stop.
 7. Valve shall utilize a reduced port design that provides velocity head recovery.
 8. Valve temperature range shall be from -4°F (-20°C) to 250°F (121°C).
 9. Valve shall have either NPTF thread or SWTF end connections.
 10. Valves with NPT end connections shall be rated for 400 PSIG working pressure.
 11. Valves with SWTF end connections shall be rated for a maximum of 300 PSIG working pressure.
- B. Provide strainer valve body constructed out of lead free brass, see detail.
- C. Install in accordance with manufacturer's instructions.

2.17 MISCELLANEOUS CONNECTIONS

- A. Make all domestic water, waste, vent, gas, air, etc., connections to all equipment in this building whether or not such equipment is furnished under this section or under other sections of the specification. This includes furnishing piping, traps (if required) and shut-off valves on branches to and from each piece of equipment from mains or branch mains.
- B. Make all plumbing connections to existing piping and to all equipment shown on the plans as requiring same. If specific piping details are not shown, the equipment shall be roughed in for and connected in accordance with the manufacturer's recommendations. It will be this contractor's responsibility to obtain shop drawings from whomever furnishes the equipment.

2.18 TESTING/CLEANING

- A. The mechanical contractor is responsible for the testing & cleaning of each respective system in accordance with applicable state and local codes. Tests shall be repeated until each system is proven acceptable.

END OF SECTION 22 4000

**SECTION 23 0500
GENERAL HVAC REQUIREMENTS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The mechanical contractor shall perform all work and furnish all materials as indicated in the mechanical plans and specifications as necessary for the successful completion of this project.

1.3 PERMITS AND SERVICES

- A. The mechanical contractor shall obtain all permits and arrange all inspections, give notices and pay all fees as required by the Authority Having Jurisdiction.
- B. This contractor shall coordinate any necessary site utilities including water, natural gas, and sewer work with local utility, owner, and other contractors to minimize disruption and downtime. ANY AND ALL CHARGES ASSESSED BY THE UTILITY OR CITY TO ACCOMMODATE THE REQUIREMENTS OF THIS PROJECT ARE THE SOLE RESPONSIBILITY OF THE MECHANICAL CONTRACTOR. VERIFY ALL CHARGES AND COORDINATE ALL EQUIPMENT NECESSARY WITH THE UTILITY BEFORE SUBMITTING BID.

1.4 DRAWINGS AND MEASUREMENTS

- A. Verify all dimensions and conditions with Architectural and Structural drawings. The small scale of the drawings prohibits the indication of all offsets, fittings and accessories necessary and shall be furnished by this Contractor and required for complete and proper operation.
- B. "Existing Conditions" shown on drawings are based on existing plans and limited field investigation. The field survey was conducted to verify, as much as possible, the accuracy of the locations shown. The Contractor shall verify the accuracy of the "Existing Conditions" as shown on the drawings. As the demolition work progresses perform modifications and additions as necessary to correct for these hidden conditions and allow for the completion of the new work.
- C. The general arrangement of the mechanical systems shall be as shown on the drawings. Field changes shall have the written acceptance of the Engineer.
- D. Consult the drawings and specifications of all other trades. Layout work and coordinate with other trades, before installing any equipment, to avoid interfering with these trades or conflicting with applicable codes.
- E. The mechanical contractor shall bear full responsibility for coordinating his work with other trades to avoid conflicts in space requirements, clearances, etc. Problems arising due to lack of coordination will be the responsibility of the mechanical contractor to resolve. Extra work and/or equipment as a result of not coordinating work shall be the responsibility of the installing contractor and at no cost to the Owner.

1.5 INSPECTION OF SITE AND DOCUMENTS

- A. Before submitting a proposal on the work contemplated, the bidder shall thoroughly familiarize himself with the contract documents, the site, and all existing conditions and limitations that may affect the performance of his work. Any conflict noted shall be brought to the attention of the Engineer before bidding. If there is not sufficient time prior to bidding, the Contractor shall bid the larger quantity or better quality of work.
- B. No extra compensation will be allowed, because of misunderstanding the amount of work involved or the bidder's lack of knowledge, for obvious conflicts which could have been discovered or reasonably anticipated prior to bidding.

1.6 REGULATIONS AND CODES

- A. All work, materials, and equipment in this contract shall comply with all applicable local, city, state and federal ordinances, regulations, and codes.

1.7 INSTRUCTIONS

- A. Furnish verbal and engineer approved written instructions to Owner on all systems. Instruction shall include operating procedures, adjustments, and periodic maintenance. Furnish a copy of the written instructions and attach a letter to the Engineer, prior to final inspection, signed by Owner, attesting to date and satisfaction of instructions.

1.8 OPERATING AND MAINTENANCE MANUALS (3 Hard Copies & 1 Electronic Submittal via Submittal Exchange)

- A. PRIOR TO FINAL INSPECTION, The mechanical contractor shall furnish (3) hard copies (including 1 USB drive containing electronic copy) and (1) electronic submittal via Submittal Exchange of the O&M Manuals to the Engineer, containing all pertinent data to the mechanical systems. Information shall be indexed and labeled per system and shall include catalog cuts, installation manuals, maintenance manuals, manufacturer's names, replacement parts list. Include balancing reports as specified. Include written instructions and warranty info as specified.
- B. The first section shall be indexed/labeled "WRITTEN INSTRUCTIONS & TRAINING" noting written instructions with company service contact info and shall include a list of filters for each unit. Also include document with owners signature attesting to date and satisfaction of training.
- C. The second section shall be indexed/labeled "WARRANTY INFO" and shall include a statement of guarantee on the contractors company letter head and shall include warranty statements of all equipment provided/installed under his contract with specific dates. This will note any longer/special warranties.

1.9 AS-CONSTRUCTED DRAWINGS (Red Lined on Plans & USB Drive containing scanned PDF)

- A. During construction, each trade shall keep track of the major changes in the rerouting of piping and equipment, and shall note these in red on one set of drawings. This set of drawings shall be submitted with the Operation and Maintenance Manuals along with a USB drive containing a single PDF file with these same red line plans in electronic form. Most printing shops will be able to scan your trade's large plan sheets into electronic form. Contact the engineer's office if there are any questions.

1.10 WORKMANSHIP

- A. Qualified individuals that are properly licensed to perform the work involved shall perform all mechanical work.

1.11 CUTTING AND PATCHING

- A. This Contractor shall be responsible for all cutting and patching of holes required for passage of piping, equipment, and ducts. This also applies to the removal or installation of new equipment.
- B. All cutting of existing construction required to install or join new work, except where otherwise indicated on the plans, shall be the responsibility of this Contractor and coordinated with the Construction Manager. Before making any cuts, verify exact locations and sizes with the Construction Manager to confirm that no structural members will be cut. Contractor shall make every effort to minimize extent of cutting existing construction.
- C. The mechanical contractor shall be responsible for patching any openings left in floors, walls, and ceilings that were caused by his/her actions. Patching shall match existing surface in color, texture and quality so that patch is indistinguishable from original surface.

1.12 PAINTING

- A. Any equipment which becomes rusted or damaged during construction shall be repaired, cleaned, and repainted by this Contractor. Painting shall always be applied in two coats, one primer and one finish.

1.13 EQUIPMENT AND PIPE SUPPORTS

- A. Provide all structural supporting frames, steel stands, concrete bases, and hangers as required for mechanical equipment. All floor equipment shall be set on 4" high concrete bases furnished by this Contractor, unless otherwise noted.
- B. Paint all unprotected metal, except galvanized and copper, with metal protective paint.
- C. **Hangers for piping shall be large enough to encompass insulation. It shall not be acceptable for insulation to envelope hangers/saddles, or for insulation to stop on either side of hangers.**
- D. Provide saddles at all hangers or supports of insulated piping. Saddles for 4" and larger piping shall be fabricated of 14 gauge galvanized iron, and for smaller piping shall be fabricated of 16 gauge galvanized iron. Saddles shall be one-half the circumference of the pipe insulation and 4" shorter than the insulation inserts.
- E. Under no condition shall any pipe or duct structure be used to support another.

1.14 ACCESS TO EQUIPMENT

- A. Access shall be provided to all motors, valves, dampers, controls, specialties, etc., for maintenance purposes. All access doors, access panels, removable sections, etc., required for access shall be provided. The location of the access openings relative to the mechanical equipment shall be coordinated to assure proper access to the equipment.
- B. Access openings are required for manual, motorized, fire, and smoke dampers and other devices requiring access and shall be provided in the ductwork, plenums, housings, tanks, etc., under this portion of the contract.

1.15 EXCAVATING AND BACKFILLING

- A. When work to be completed by this contractor requires trenching, digging, etc. this contractor shall be responsible for properly protecting open trenches in accordance with required safety procedures. Backfill shall be placed in horizontal layers, not exceeding 9 inches in thickness. Moisten and hand or machine compact to 95% of standard proctor density. Bring fill to elevations indicated. If backfill fails the proctor density test in accordance with ASTM D-2049 and conducted by an independent testing laboratory retained by the owner, Contractor shall recompact and retest until satisfactory density is reached. This contractor shall restore the surface (whether grass, asphalt, concrete, etc.) to its original condition. Grass shall be seeded to match surrounding turf.
- B. When work is in public street, paving repairs shall be equal to and comply with municipal agency requirements. If repairs are done by municipal agency, make necessary arrangement with such agency to make the repairs. Contractor shall include cost for permits, inspection fees, work, etc. in Mechanical Bid.

1.16 TESTING AND ADJUSTING

- A. At the completion of work, all parts of the installation under Division 23 shall be cleaned, lubricated, tested, and adjusted for proper operation.
- B. All piping and ductwork shall be tested and cleaned as required, by all local, state and federal codes. Tests shall be performed in the presence of the authority having jurisdiction. Written notification of test, date, and results shall be furnished to the Engineer before concealing or covering the installation.
- C. All controls shall be tested and adjusted for proper operation. Adjustments shall be made when all systems are operating which may affect the control system.
- D. An Independent Testing & Balancing Agent shall test and balance all mechanical systems as specified in Section 23 0593.

1.17 GUARANTEE

- A. Warranty: The mechanical contractor shall warrant his work against failure and workmanship for a period of at least one year from the date of substantial completion, for all new work. Any work that is defective within that one-year period shall be replaced by the Contractor without

charge. If longer/special warranties are noted elsewhere in the specifications, those warranties shall apply.

1.18 EQUIPMENT IDENTIFICATION

- A. Major mechanical equipment, rooftop units, energy recovery ventilators, electric duct heaters, heat pumps, exhaust fans, etc. shall be provided with identification as designated on the plans. Labels shall be black laminate three-layer plastic with engraved 1/2 inch white letters, adhered, screwed, or riveted to the equipment. Manufactured by Brady, Champion America/Seton.
- B. Piping shall be identified as to contents and flow direction with plastic, color coded, snap-on or adhesive labels. Manufactured by Brady, Champion America/Seton.
 - 1. Labeling shall be located:
 - a. Adjacent to each valve.
 - b. At each side of and at each obstruction.
 - c. At each branch.
 - d. At each cap for future.
 - e. At each takeoff.
 - f. At each side of penetration of structure or enclosure.
 - g. At each equipment connection.
 - h. At all access doors.
 - i. A maximum of every 40 feet on straight runs of piping including rises and drops.
 - j. Minimum one label per room/space.
- C. Valve tags shall be brass with stamped letters, tag size 1-1/2" minimum in diameter.
 - 1. Provide typed valve lists in each O&M binder. Valve lists shall include the valve number, location, and purpose of each valve, and any other necessary information such as the required opening or closing of another valve when one valve is to be opened or closed.
- D. Color coded indicators shall be installed on the ceiling grid or access door to hard lid areas to indicate all valves and other ceiling mounted equipment requiring service (example – VAV's). Each trade shall be responsible for equipment provided under their respectable trade.
 - 1. Each ceiling label shall be color coded laminated engraved plastic, 1/16" thick, 2.5" wide by 0.75" tall, with white lettering centered on each label. Label to be adhered to the acoustic ceiling tile grid. Seton Style AV0175 or similar.

1.19 MECHANICAL SUBMITTAL

- A. All equipment shall be as listed on the equipment schedules or approved equal.
- B. Prior Approval: Manufacturers whose product is not specified or specifically listed on the plans or in the specifications are allowed to submit information on a product that they would like to be considered as an equal to those specified or listed. By submitting this information for consideration, the product representative is indicating that the product being presented for consideration equals or exceeds the specified product in quality, performance and operating parameters. Proof of equality rests with the party making the request. The procedure for this submittal is listed below.
- C. Submit literature on product that is to be considered for prior approval. This literature shall include catalog cuts with all pertinent technical specifications, dimensions and pictures of the product.
- D. Final approval of all equipment shall be contingent on shop drawing acceptance, compliance with the specifications and performance criteria as required. General approval to bid a product does not relieve the supplier or contractor of meeting specific specification requirements.
- E. The Mechanical Contractor shall pay, provide, install and be responsible for any extra materials required due to his use of alternate accepted equipment which has installation requirements different than the specified equipment. This includes paying other trades for any extra work they are involved in due to this substitution of equipment.
- F. Literature shall be submitted so that the engineer receives it no later than 7 days prior to bid date.

- G. All approvals will be in the form of an addendum issued to all plan holders.
- H. List of Acceptable Substitutions:
 - 1. Equipment Identification, Pipe Labeling, Valve Tags, Ceiling Grid Labeling: Seton, Brady Corporation, Marking Services Incorporated
 - 2. Water Heater Venting System: Selkirk, Metal Fab, Heat Fab, Duravent
 - 3. Packaged Cooling Only Rooftop Unit: AAON (must provide technical submittal during prior approval process)
 - 4. Shutoff VAV Terminal Units: Carrier, Price, Krueger, Nailor, Trane, Tuttle & Bailey, Titus, JCI
 - 5. Fan Coils with DX Cooling: Daikin, York, Carrier, Armstrong Air, Lennox
 - 6. Air Cooled DX Condensing Unit: Daikin, York, Trane, Fraser/Johnson
 - 7. Duct Mounted Hot Water Heating Coils: Daikin, Trane, York/JCI, Super Radiator, Precision Coil, Capitol Coil
 - 8. Power Roof Ventilator Exhaust Fans: PennBarry, Greenheck, Loren Cook, ACME, ILG Air Specialties Express/Carnes, Aerovent, Twin City Fan & Blower
 - 9. Registers, Grilles, & Diffusers: Metalaire, Price, Tuttle & Bailey, Krueger, Nailor, Hart & Cooley, Anemostat, Nailor, J & J Register, Air Specialties Express/Carnes, Titus
 - 10. Intake & Relief Hoods: ACME, Ruskin, Pottorff, Arrow United Industries, Greenheck, Air Balance, Nailor, NCA, Safe-Air Dowco
 - 11. Smoke, Fire, & Combination Dampers: Ruskin, Safe Air, Air Balance, Nailor, Cesco, Advance Air, Air Control Products, International Air, Greenheck, Pottoff, Lloyd, NCA, United Enertech
 - 12. Hydronic Pumps: Armstrong, Taco, B&G, Allis-Chalmers, General Signal Pump Group, Thrush, Patterson, Grundfos, Pentair
 - 13. Hydronic Expansion Tanks: Bell & Gossett, Taco, Wessels, Watts, Armstrong, Thrush, Grundfos, Amtrol, American Wheatley, Elbi, Pentair
 - 14. Hydronic Air Separators: Bell & Gossett, Taco, Wessels, Watts, Armstrong, Thrush, Grundfos, Pentair
 - 15. Brazed Plate Heat Exchanger: Bell & Gossett, Taco, Armstrong, Thrush, Alpha Laval
 - 16. Exposed Spiral Duct: SPOT, Spiral Pipe of Texas
 - 17. Ethylene Glycol: Dow Chemical, no exceptions. Match existing.
 - 18. Propylene Glycol: Dow Chemical, no exceptions. Match existing.
 - 19. Pressure-compensating Flow Control and Strainer Valves: Pro Hydronics, Griswold, Autoflow, B&G, Nexus, Flow Design, IMI Flow Design
 - 20. Manual Flow Control Valves: Pro Hydronics, Griswold, Autoflow, B&G, Nexus, Flow Design, IMI Flow Design
 - 21. Hydronic Air Separators: Bell & Gossett, Taco, Wessels, Watts, Armstrong, Thrush, Grundfos, Pentair, Spirovent, Caleffi
 - 22. Hydronic Expansion Tanks: Bell & Gossett, Taco, Wessels, Watts, Armstrong, Thrush, Grundfos, Pentair, Amtrol
 - 23. DDC Temperature Controls: Facilities Explorer by Metropolitan Mechanical Contractors, no exceptions. Extension of existing system.

1.20 SHOP DRAWINGS

- A. Before ordering any item, Contractor shall review, stamp with his approval and submit shop drawings of equipment as to be furnished under this contract.
 - 1. Electronic submittals are REQUIRED. Electronic submittals can be one combined .pdf. for each of the following mechanical trades: Fire Sprinkler Drawings, Fire Sprinkler Calcs, Fire Sprinkler Materials, Temperature Controls, HVAC, Plumbing, and Hydronics.
- B. Where the contractor is submitting shop drawings that differ from the plans and specifications, the contractor must notify the engineer in writing each variance from the plans and specifications and the Mechanical Contractor shall pay, provide, install and be responsible for any extra materials required due to his use of alternate accepted equipment which has installation requirements different than the specified equipment. This includes paying other trades for any extra work they are involved in due to this substitution of equipment.

- C. Product Data shall include, but are not limited to, the following: Manufacturer's product specifications, Manufacturer's installation instructions, standard color charts, catalog cuts, roughing-in diagrams and templates, and standard wiring diagrams.

1.21 TEMPORARY HEAT

- A. Temporary heating of the building during construction will be provided as specified in the General Conditions and Supplemental General Conditions. Under no circumstance shall the proposed HVAC equipment be brought into service as temporary heating prior to project completion without written permission from the mechanical engineer & owner.

1.22 EXECUTION

- A. Remove equipment as indicated. Demolition work shall be coordinated with the Owner. Should questions arise regarding the removal of equipment, confer with the owner before such equipment is demolished.
- B. Materials removed by demolition shall remain the property of the Owner unless specifically noted. Material the Owner does not wish to retain shall be removed and properly disposed of by the Contractor.
- C. The existing building will be in use during this construction. Schedule and carry out the work in such a manner as to cause the Owner a minimum of inconvenience due to service interruptions. Temporary services shall be installed if one area or phase of construction disrupts service to another area of the building or if equipment has to be relocated to allow construction to progress. Service interruptions shall be confined to the smallest area possible at any one time and interruptions shall be scheduled with the Owners site representative. After service has been restored following an interruption, inspect areas affected by the interruption and be responsible for returning automatically controlled equipment to the same operating condition that existed prior to the interruption.
- D. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.
- E. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- F. Coordinate mechanical equipment and materials installation with other building components. Verify all dimensions by field measurements. Arrange for chases, slots, and openings in other building components to allow for mechanical installations.
- G. Final locations of equipment may differ slightly from those shown on these plans. Coordinate exact location of equipment with equipment supplier, structural members, furniture layout and other trades before rough in and adjust accordingly. Pricing shall allow for a minimum of 10 ft. of difference in the actual location of items as compared to the location shown on the drawings.
- H. All penetrations for piping, ductwork, etc. which penetrate floors, fire and/or smoke walls, roofs, full height partitions and similar structures shall be sealed by the mechanical contractor with a UL system specifically approved for the application. This system must maintain the required fire rating.
- I. All mechanical systems shall be tested and cleaned as required by Authority Having Jurisdiction.
- J. The mechanical contractor shall have the full responsibility of ensuring that his/her work is performed in a safe manner and shall bear all liability associated with his/her job site safety.
- K. Upon completion of the work, the Contractor shall notify the A/E and make arrangements for a final inspection. Contactor shall provide A/E with copy of all required balance reports prior to the final inspection.
- L. After the final inspection is made, the Contractor will receive a list of items requiring adjustment, correction, replacement, or completion.

- M. The Contractor shall comply completely with all listed requirements within (40) days of receipt of list. Should the Contractor fail to perform within this time limit, the A/E and/or Owner reserves the right to have the work completed by others and the cost deducted from the contract price.

END OF SECTION 23 0500

**SECTION 23 0510
BASIC HVAC MATERIALS AND METHODS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This section includes the following basic mechanical materials and methods to complement other Division 23 Sections.
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Sleeves.
 - 5. Escutcheons.
 - 6. Grout.
 - 7. Mechanical Demolition.
 - 8. Concrete bases.
 - 9. Installation requirements common to equipment specification sections.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 QUALITY ASSURANCE

- A. All piping shall be specified in this section. Material and installation shall also be subject to state, local codes and ordinances of the area encompassing this project.
- B. Delete first paragraph below if no welding. AWS states that welding qualifications remain in effect indefinitely unless welding personnel have not welded for more than six months or there is a specific reason to question their ability.
- C. Welder's Qualifications: All welder shall be qualified in accordance with ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- D. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."
- E. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Provide piping and factory fabricated fittings as indicated for each service and pipe size. Fitting sizes and types shall match piping or equipment connections. Where not indicated, comply with governing regulations or manufacturer's recommendations.

2.2 SLEEVES

- A. The following materials are for wall, floor, slab, and roof penetrations:
 - 1. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
 - 2. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
 - 3. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
 - 4. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.3 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- C. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.

2.4 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.5 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

PART 3 - EXECUTION

3.1 MECHANICAL DEMOLITION

- A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.

2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Do not run piping through electrical or electronic equipment spaces and enclosures unless unavoidable. Install drip pan under piping that must be run through electrical spaces, if approved by local authority.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Install piping to permit valve servicing.
- H. Install piping to allow maximum possible headroom unless specific mounting heights or slopes are indicated.
- I. Install piping at indicated slopes, or level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- J. Install piping free of sags and bends.
- K. Install fittings for changes in direction and branch connections.
- L. Install piping to allow application of insulation.
- M. Select system components with pressure rating equal to or greater than system operating pressure.
- N. Install escutcheons for penetrations of walls, ceilings, and floors.
- O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials conforming to the 25/50 flame spread and smoke developed rating.
- S. Verify final equipment locations for roughing-in.
- T. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

END OF SECTION 23 0510

SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes testing, adjusting, and balancing HVAC systems to produce design objectives, including the following:
 - 1. Balancing AIRFLOW and WATER flow within distribution systems, including submains, branches, and terminals, to indicated quantities according to specified tolerances.
 - 1. **Includes balancing of domestic hot water recirculation pumps and balancing valve system.**
 - 2. Adjusting total HVAC systems to provide indicated quantities.
 - 3. Verifying that automatic control devices are functioning properly.
 - 4. Reporting results of activities and procedures specified in this Section.
- B. **Also include all balancing of existing equipment and systems where indicated on the plans.**

1.3 DEFINITIONS

- A. Retain acronyms and abbreviations that remain after this Section has been edited for Project.
- B. AABC: Associated Air Balance Council.
- C. AMCA: Air Movement and Control Association.
- D. NEBB: National Environmental Balancing Bureau.
- E. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.4 SUBMITTALS

- A. Certified Testing, Adjusting, and Balancing Reports: Prepared on approved forms certified by the testing, adjusting, and balancing Agent.

1.5 QUALITY ASSURANCE

- A. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by AABC or NEBB or Engineer's approved equal.
- B. Certification of Testing, Adjusting, and Balancing Reports: Certify testing, adjusting, and balancing field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
 - 2. Certify that testing, adjusting, and balancing team complied with approved testing, adjusting, and balancing plan and procedures specified and referenced in this Specification.
- C. Testing, Adjusting, and Balancing Reports: Use standard forms approved by the Engineer.
- D. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
- E. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by the instrument manufacturer.

1.6 PROJECT CONDITIONS

- A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the Owner during testing, adjusting, and balancing operations to minimize conflicts with the Owner's operations.

1.7 COORDINATION

- A. Coordinate efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist testing, adjusting, and balancing activities.
- B. Provide 7 day's advance notice for each test including scheduled test dates and times.
- C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine approved submittal data of HVAC & domestic recirc pump systems and equipment.
- B. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- C. Examine system and equipment test reports.
- D. Examine HVAC & domestic recirc pump system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- E. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- F. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- G. Examine strainers for clean screens and proper perforations.
- H. Examine hydronic & domestic recirc equipment for correct piping connections and for clean and straight fins.
- I. Examine equipment for installation and for properly operating safety interlocks and controls.
- J. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices operate by the intended controller.
 - 2. Verify dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Sensors are located to sense only intended conditions.
 - 6. Sequence of operation for control modes is according to the Contract Documents.
 - 7. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
 - 8. Interlocked systems are operating.
- K. Report to the Engineer deficiencies discovered before and during performance of testing, adjusting, and balancing procedures.

3.2 TESTING AND BALANCING PROCEDURES

- A. Perform testing and balancing procedures on each system according to procedures contained in AABC national standards.

- B. Perform testing and balancing procedures on each system according to procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
- C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
- D. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

3.3 TOLERANCES

- A. Set HVAC system airflow and domestic & hydronic water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans: Plus 10 to minus 10 percent.
 - 2. Air Outlets and Inlets: Plus 10 to minus 10 percent.
 - 3. Hydronic & Domestic Water Flow Rate: 0 to minus 10 percent.

3.4 REPORTS

- A. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.
- B. Final Report: Typewritten, or computer printout in letter-quality font, on standard bond paper, bound in three-ring, loose-leaf binder, and tabulated and divided into sections by tested and balanced systems.
 - 1. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing agent.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
 - 3. Final Report Contents: In addition to certified field report data, include the following:
 - a. Pump curves.
 - b. Fan curves.
 - c. Manufacturers' test data.
 - d. Field quality-control test reports prepared by system and equipment installers.
 - e. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
 - 4. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 - f. Title page.
 - g. Name and address of testing, adjusting, and balancing Agent.
 - h. Project name.
 - i. Project location.
 - j. Architect's name and address.
 - k. Engineer's name and address.
 - l. Contractor's name and address.
 - m. Report date.
 - n. Signature of testing, adjusting, and balancing Agent who certifies the report.

3.5 ADDITIONAL TESTS

- A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

- B. Seasonal Periods: If initial testing, adjusting, and balancing procedures were not performed during near-peak summer and winter conditions, perform additional inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION 23 0593

**SECTION 23 0700
HVAC SYSTEMS INSULATION**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The work in this section of the specification and the accompanying drawings consists of performing all labor, equipment, accessories, and materials and in performing all operations necessary for the installation of all insulation for the duct systems and sealing of sleeves.
- B. Work to be insulated includes the following:
 - 1. All voids within roof curbs.
 - 2. All supply air, return air, transfer air, outside air, relief air, and exhaust air ducts.
 - 3. All circulating above ground heating water piping, valves, and fittings.
 - 4. All circulating above ground heating water air separators (reinsulate existing air separator), and other heating water equipment as required.
 - 5. All circulating above ground chilled water piping, valves, and fittings.
 - 6. All circulating above ground chilled water equipment as required.
 - 7. All above ground cooling condensate drainage piping.
 - 8. All sleeves.
- C. All insulation work shall be installed in a workmanlike manner by skilled workmen engaged in this type of work.
- D. Fire-Test-Response Characteristics: Provide products with flame-spread and smoke-developed indices of 25 and 50, respectively, according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction.

1.3 SUBMITTALS

- A. Shop drawings/product data as specified in Section 23 0500 shall include the following:
 - 1. Product Data: Identify thermal conductivity, thickness, and jackets (both factory installed and field applied, if any), for each type of product indicated.

1.4 COORDINATION

- A. Coordinate clearance requirements with duct Installer for insulation application.
- B. Coordinate clearance requirements with piping Installer for insulation application.
- C. Coordinate size and location of supports, hangers, and insulation shields.
 - 1. All hangers and insulation shields for piping shall be large enough to encompass insulation without penetrating vapor barrier.
 - 2. It shall not be acceptable for insulation to envelope hangers/saddles.
 - 3. It shall not be acceptable for insulation to terminate on either side of hangers not properly sized to encompass insulation.

PART 2 - PRODUCTS

2.1 DUCTWORK INSULATION

- A. RIGID BOARD DUCT INSULATION
 - 1. Rigid Board shall be fiberglass, CertainTeed type IB with FSK reinforced foil scrim-kraft jacket or accepted equal. Board density shall be 3 lb/cubic foot with thermal conductivity of .23 at 75 degrees F mean temperature. ASTM C 612, Class 1.
- B. FLEXIBLE DUCT INSULATION
 - 1. Flexible insulation shall be fiberglass, CertainTeed standard duct wrap with FSK reinforced foil scrim-kraft jacket or accepted equal. Flexible insulation density shall be 1-1/2 lb/cubic foot with thermal conductivity of .24 at 75 degrees F mean temperature. ASTM C 553, Type I, Class B-4.
- C. DUCTWORK INSULATION ACCESSORIES

1. Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.
- D. DUCTWORK INSULATION COMPOUNDS
 1. Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.
- E. INSULATION THICKNESS FOR DUCTWORK: All ducts are to be insulated unless otherwise noted. Insulation thickness and type shall be as follows:
 1. VAV System Supply Air:
 - a. Rectangular Supply duct insulation before the VAV shall be exterior and 1-1/2" thick.
 - b. Round Supply duct insulation before the VAV shall be exterior and 1-1/2" thick.
 - c. Rectangular Supply duct insulation after the VAV shall be interior and 1/2" thick.
 - d. Round Supply duct insulation after the VAV shall be exterior and 1-1/2" thick.
 2. Single Zone System Supply Air:
 - a. Rectangular Supply Air duct insulation shall be interior and 1/2" thick.
 - b. Round Supply duct insulation shall be exterior and 1-1/2" thick.
 3. Rectangular Return Duct Insulation shall be interior and 1/2" thick.
 4. Outside Air Duct Insulation shall be exterior and 2" thick.
 5. Transfer Duct Insulation shall be interior and 1/2" thick.
 6. Transfer Sleeves Insulation shall be interior and 1/2" thick.
 7. Exhaust Air Duct Insulation shall be exterior and 1-1/2" thick within 15' of exterior termination unless otherwise noted.
 - a. All exhaust ductwork serving inline exhaust fans shall be insulated between inline exhaust fan and exterior termination.
 8. **For exposed ducts as noted on the Drawings with exterior insulation: Ducts shall be insulated with rigid fiberglass insulation only, including ducts routed above open exposed grid. See HVAC and architectural ceiling plans.**
 9. Where ductwork does not have exterior wrapped insulation, and sheet metal is exposed, sheet metal ductwork to be paint grip (spiral where round), see plans.

2.2 CIRCULATING ABOVE GROUND HEATING PIPING INSULATION

- A. All piping in concealed and exposed areas shall be insulated with fiberglass pipe insulation with all service jacket. Jacket shall be factory-applied, and, where specified, with white foil scrim-kraft vapor barrier. Insulation shall be Johns-Manville Micro-Lok 850 HP, or accepted equal.
- B. For pipe sizes to individual terminal units 1" and less – insulation thickness shall be 1/2". For pipe sizes of 1-1/4" thru 2" – insulation thickness shall be 1". For pipe sizes of 2-1/2" and larger – insulation thickness shall be 1-1/2".
- C. Fittings, valves, flanges, etc. shall be insulated with fiberglass blanket, Johns-Manville Microlite or pre-cut mitered sections for elbows, J-M Micro-Lok (1lb/cu. ft. density).
- D. Encase pipe fitting insulation with one piece pre-molded Zeston 2000 PVC fitting covers having flame spread index of 25 or less, and smoke developed index of 50 or less, as tested by ASTM E84 (NFPA 255) method.
- E. Provide sheet metal insulation shields at all hanger locations.
- F. **Hangers for piping shall be large enough to encompass insulation. It shall not be acceptable for insulation to envelope hangers/saddles, or for insulation to stop on either side of hangers.**

2.3 HEATING WATER AIR SEPARATORS, & OTHER HEATING WATER EQUIPMENT INSULATION

- A. All surfaces shall be insulated with 3 lb. density fiberglass board Johns-Manville #814-450 °F at a thickness of 3".
- B. Insulation shall be cut or mitered where necessary to fit the contour of the equipment. All voids shall be packed with light density glass fiber insulation. Insulation sections shall be banded in place with 3/4 inch x 0.015 inch thick galvanized steel bands at 18 inch o.c. for all large equipment. Insulation shall be covered with one inch galvanized hexagonal wire mesh. Apply 1/2 inch of insulating cement such as OC-110 or equal in 2 layers over the wire mesh.

- C. Reinsulate existing heating water air separator.

2.4 CIRCULATING ABOVE GROUND CHILLED WATER PIPING INSULATION

- A. All piping in concealed and exposed areas shall be insulated with fiberglass pipe insulation with all service jacket. Jacket shall be factory-applied, and, where specified, with white foil scrim-kraft vapor barrier. Insulation shall be Johns-Manville Micro-Lok 850 APT, or accepted equal.
- B. For pipe sizes to individual terminal units 1" and less – insulation thickness shall be 1". For pipe sizes of 1-1/4" thru 2" – insulation thickness shall be 1". For pipe sizes of 2-1/2" and larger – insulation thickness shall be 1-1/2".
- C. Fittings, valves, flanges, etc. shall be insulated with fiberglass blanket, Johns-Manville Microlite or pre-cut mitered sections for elbows, J-M Micro-Lok (1lb/cu. ft. density).
- D. Encase pipe fitting insulation with one piece pre-molded PVC fitting covers having flame spread index of 25 or less, and smoke developed index of 50 or less, as tested by ASTM E84 (NFPA 255) method.
- E. Provide sheet metal insulation shields at all hanger locations.
- F. ***All autoflow valves & strainers to be insulated & allow access to ports. Include valve extensions as necessary.***
- G. ***Hangers for piping shall be large enough to encompass insulation. It shall not be acceptable for insulation to envelope hangers/saddles, or for insulation to stop on either side of hangers.***

2.5 CHILLED WATER EQUIPMENT INSULATION

- A. All surfaces shall be insulated with 3 lb. density fiberglass board Johns-Manville #814-450 °F at a thickness of 3".
- B. Insulation shall be cut or mitered where necessary to fit the contour of the equipment. All voids shall be packed with light density glass fiber insulation. Insulation sections shall be banded in place with 3/4 inch x 0.015 inch thick galvanized steel bands at 18 inch o.c. for all large equipment. Insulation shall be covered with one inch galvanized hexagonal wire mesh. Apply 1/2 inch of insulating cement such as OC-110 or equal in 2 layers over the wire mesh.

2.6 COOLING CONDENSATE PIPING

- A. All new piping in concealed and exposed areas shall be insulated with flexible elastomeric thermal insulation consisting of closed-cell, sponge- or expanded rubber materials. Comply with ASTM C 534, Type I for tubular materials, Type II for sheet materials. Maximum thermal conductivity of 0.28 at 75 degrees.
 - 1. Provide adhesives as recommended by insulation material manufacturer.
 - 2. Provide ultraviolet-protective coating as recommended by insulation material manufacturer.
- B. Insulation thickness shall be 1/2" and shall include a vapor retarder.
- C. Fittings, valves, flanges, etc. shall be insulated with prefabricated thermal insulating fitting covers complying with ASTM C 450 for dimensions used in performing insulation to cover valves, elbows, tee, and flanges.
- D. Install per manufacturer's recommendations.

PART 3 - EXECUTION

3.1 GENERAL APPLICATION

- A. All insulation shall be applied on clean, dry surfaces. All joints shall be snugly butted against the adjoining piece and all joints, seams, voids, flat spots, etc., shall be filled with insulation cement. Do not use cut pieces or scraps abutting each other.
- B. Where double layers are installed, the first layer shall be fastened with binding wire. All joints shall be staggered between the two layers.

- C. Insulation on all cold surfaces must be applied in a continuous, unbroken vapor seal. Hangers, supports, anchors, etc., that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation.
- D. All surface finishes shall be extended to protect all surfaces, ends, and raw edges of insulation.
- E. All insulation materials shall be installed in strict accordance with manufacturer's instructions, using recommended adhesives, mastics and coatings applied at specific coverage per gallon and temperature conditions.
- F. Extend insulation without interruption through walls, floors and similar penetrations, except where otherwise indicated.
- G. Maintain integrity of vapor-barrier jackets on insulation, and protect to prevent puncture or other damage.
- H. Do not apply insulation to equipment, breechings, or stacks while hot.
- I. Do not insulate boiler manholes, handholes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.
- J. Provide removable insulation sections to cover parts of equipment, which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.
- K. Repair damaged sections of existing mechanical insulation, both previously damaged or damaged during this construction period. Use insulation of same thickness as existing insulation, install new jacket lapping and sealed over existing.
- L. Insulation installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

3.2 DUCT APPLICATION

- A. Rigid Insulation shall be secured to duct or sheet metal work by impaling over pin anchors space no more than 12" centers and secured with washers and clips. Pins shall be spot welded to the duct surface by a welding procedure which will not distort the sheet metal or burn through or mar interior finish of the duct plenums of casings but which develop full strength of the pin. Pin sizes and diameters shall be as recommended by manufacturer for type and thickness of insulation specified. Insulation on the underside of all horizontal or sloping ducts shall be additionally secured with 3M Insulation Adhesive 35.
- B. Insulation shall be applied with all joints tightly butted and all points of impalement shall be pointed up and sealed with approved mastic before positioning clips. Where vapor barrier is specified, all joints, breaks, punctures and voids shall be filled with vapor barrier coating compound and covered with vapor seal material identical to the surrounding material.
- C. All joints, duct attachments, and junctions (including those caused by ducts entering walls, projections such as hanger, etc.) shall be pointed and sealed with approved mastic and taped. Where no further finish is required over the vapor barrier, taping shall be carefully done to obtain a neat finished appearance.
- D. Flexible Insulation shall be adhered to duct with fire-retardant adhesive in sufficient quantities to prevent sagging. Ducts with a width over 30" shall be further secured on the underside with mechanical fasteners on 12" maximum centers. Insulation shall be butted with facing overlapping all joints at least 2" and sealed with fire-retardant vapor barrier adhesive. Seal all breaks and punctures with vapor barrier tape and same type of fire retardant adhesive.

3.3 MINERAL-FIBER PIPE INSULATION APPLICATION:

- A. Fittings, valves, and flange insulation shall be wrapped firmly under compression (minimum 2:1) to a thickness equal to the adjoining insulation, secured with No. 20 gauge galvanized annealed steel wire, and finished with a smoothing coat of mastic, Johns-Manville No. 375 Insulating and Finishing Cement or equal.
- B. Cold Fittings, Valves, Flanges, etc., shall be additionally sealed with a layer of resin coated glass mesh, such as Johns-Manville Duramesh 207 glass cloth, embedded between two 1/16"

thick coats of vapor barrier coating, Benjamin Foster 30-35 or equal. Lap the sealed glass cloth at least 2" on itself and the adjoining insulation.

- C. Premolded Insulation Valve and Fitting Covers and valve insulating bags shall be installed by tack fastening, banding, or taping as required by manufacturer.
- D. Expansion Joints: For expansion joints, a tube of pipe insulation shall be fabricated that will allow the expansion joint to move within the tube. The insulating tube shall be fastened at one end of the pipe or equipment and the other end shall be free to slide over the adjacent insulated piping. Provide an aluminum jacket over the insulated pipe to provide a smooth surface on which the insulated tube may slide.
- E. Insulation Under Hangers: Pipe hangers shall encompass the insulation and shall have sheet metal saddles furnished by the Mechanical Contractor.
- F. Inserts shall be installed at all hanger locations. Inserts between the pipe and pipe hangers shall consist of 13lb/cubic foot hydrous calcium silicate pipe insulation, or wood blocking, of thickness equal to the adjoining insulation and shall be provided with vapor barriers where required. Insulation inserts shall not be less than the following lengths:
 - 1. 1/2" to 1-1/2" pipe size 10" long
 - 2. 3" to 6" pipe size 12" long
 - 3. 8" and larger pipe size 16" long
- G. On all piping the full thickness of insulation and jacket shall run continuously under the sheet metal pipe saddle and through the pipe hanger (pipe hanger shall be large enough to permit full insulation thickness.)

3.4 FLEXIBLE ELASTOMERIC PIPE INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
 - 1. Follow manufacturer's written instructions for applying insulation.
 - 2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- B. Apply insulation to fittings and elbows as follows:
 - 1. Apply mitered sections of pipe insulation.
- C. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
- D. Insulation Under Hangers: Pipe hangers shall encompass the insulation and shall have sheet metal saddles furnished by the Mechanical Contractor.
- E. Inserts shall be installed at all hanger locations. Inserts between the pipe and pipe hangers shall consist of 13lb/cubic foot hydrous calcium silicate pipe insulation, or wood blocking, of thickness equal to the adjoining insulation and shall be provided with vapor barriers where required. Insulation inserts shall not be less than the following lengths:
 - 1. 1/2" to 1-1/2" pipe size 10" long
 - 2. 3" to 6" pipe size 12" long
 - 3. 8" and larger pipe size 16" long
- F. On all piping the full thickness of insulation and jacket shall run continuously under the sheet metal pipe saddle and through the pipe hanger (pipe hanger shall be large enough to permit full insulation thickness.)

3.5 SEALING OF SLEEVES

- A. All sleeves for pipes, ductwork, etc., furnished under Division 23 of specifications, penetrating floors, fire and/or smoke walls and full height partitions, including chase walls, shall be sealed in accordance with the following:
 - 1. All insulated services shall have the specified insulation terminated on either side of sleeve. Services which require a vapor barrier jacket shall have segment through sleeve insulated with calcium silicate having a minimum thickness same as specified for service. Vapor barrier jacket shall be uninterrupted. Entire void space between inside of sleeve and outside of duct, pipe, and/or calcium silicate insulation shall be packed with fiber insulation, conforming to HHI-521E Type 3 or HHI-558B Form A and having an ASTM fire

class E-84 with fiber melt point in excess of 2000 degrees F., to a point 1/8 inch from ends of pipe sleeve. After void is packed with fiber insulation, services which are specified to be insulated shall have a section of insulation installed on each side of sleeve, insulation to be fitted tight to sleeve insulation. Balance of space in sleeve to be filled with nonhardening silicone conforming to TTS-00230 and of type which will allow 50 percent movement in one direction.

2. Contractor is herein given the option to provide Pipe Shield, Inc., fire rated wall and floor sleeves for insulated and noninsulated piping in lieu of sealing sleeves as outlined above. Shields shall be installed in strict accordance with manufacturer's recommendations.

END OF SECTION 23 0700

**SECTION 23 0900
CONTROLS & CONTROL SEQUENCES**

(THIS TEMPERATURE CONTROL WORK WILL BE THE RESPONSIBILITY OF THE MECHANICAL CONTRACTOR WHICH SHALL BE AN EXTENSION OF THE EXISTING DDC SYSTEM, & BE FACILITY EXPLORER BY METROPOLITAN MECHANICAL CONTRACTORS, CONTACT DONALD AHLSCHLAGER AT 701-205-3781)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. ALL TEMPERATURE CONTROLS INSTALLED BY THIS CONTRACTOR SHALL BE FIELD INSTALLED.
- B. THIS SYSTEM SHALL BE AN EXTENSION OF THE EXISTING DDC CONTROLS. THIS NEW DDC SYSTEM MUST BE FULLY INTEGRATED INTO THE EXISTING DDC SYSTEM FOR COMPLETE OPERATOR ACCESS AND CONTROL THROUGH THE EXISTING COLOR GRAPHIC WORKSTATION. CUSTOM GRAPHICAL DISPLAYS FOR THE PROPOSED FLOOR PLAN & ALL PROPOSED EQUIPMENT SHALL BE GENERATED AT THE EXISTING WORKSTATION.
- C. This Section includes controls & control sequences for HVAC systems, subsystems, and equipment.
- D. The work in this section of the specification and the accompanying drawings consists of performing all labor and furnishing of all material and equipment necessary to install a complete Automatic Temperature Control System for the heating, ventilating, and air conditioning systems as indicated on drawings and specified herein, including minor items obviously necessary for complete and operating systems. Automatic Temperature Control System shall provide the "Sequence of Operation" as described in this section.
- E. The control system shall consist of all room sensors, floor sensors, thermostats, valves, damper operators and other accessories to fulfill the intent of the specifications. The temperature control system shall be installed by trained mechanics regularly employed by the manufacturer of the temperature control system.
- F. Each microprocessor based digital controller will be able to maintain its programmed memory in a non-volatile state during power failures without the use of batteries. All components and related temperature control components such as sensors, control valves, actuators, thermostats, control panels, etc. shall be manufactured by the same vendor.

1.3 DEMOLITION/MODIFICATION

- A. The work in this section of the specification and the accompanying drawings also consists of performing all necessary demolition and modification work of the existing Automatic Temperature Control System for the heating, ventilating, and air conditioning systems.

1.4 QUALITY ASSURANCE

- A. Agent Qualifications: An Independent Engineer Approved Temperature Control Contractor shall provide and install all temperature controls and control sequences as specified in this section.

1.5 PROJECT CONDITIONS

- A. Partial Owner Occupancy: The Owner may occupy completed areas of the building before Substantial Completion. Cooperate with the trades and HVAC contractor to minimize conflicts with the Owner's operations.

1.6 BALANCING OF SYSTEMS

- A. The Temperature Controls Contractor shall cooperate and work with the mechanical contractors to properly balance out all mechanical systems to obtain a satisfactory working system.

1.7 ADJUSTMENT AND CALIBRATION OF SYSTEMS

- A. After the system is completely installed, the Temperature Controls Contractor with the presence of the mechanical engineer shall verify the various temperature control cycles as herein specified to the satisfaction of the engineer. The Temperature Controls Contractor shall submit direct to the engineer, a tabulation of all outdoor air, mixed air, discharge air, and all room temperatures for each unit. All thermostats and their thermometers shall be calibrated after installation.

1.8 SUBMITTALS

- A. Shop drawings as specified in Section 230500 shall include the following:
 - 1. All control devices, valves, dampers and auxiliary devices to be used.
 - 2. Written descriptions and diagrams to describe the operational sequences.
 - 3. Variable Frequency Drives as follows:
 - a. Refer to HVAC Motor Schedule and Mechanical Schedules on Plans for VFD's provided by TC. If there are any discrepancies or questions, contact the engineer's office prior to bidding.

1.9 CONTROLLERS & WEB-ACCESSED SYSTEM WITH CUSTOM COLOR GRAPHICS

- A. Provide BACnet Controllers that are BACnet Testing Laboratory Listed. Network communication protocol used throughout entire DDC system shall be native BACnet Communication certified by the BTL open to Owner and available to other companies for use in making future modifications to DDC system.
- B. Unless otherwise specified, all equipment described below shall be controlled and monitored via a Web-accessed system. The Web-accessed system shall allow for any owner's designated personnel to change schedules and setpoints through a PC user on the Local Area Network or remotely via the Internet. This system shall provide complete custom color graphics and password protection. This system shall allow for remote monitoring, control, and troubleshooting via the Internet.
- C. Custom Graphics of Floor Plan: Display the following data:
 - 1. Equipment Designation/Label.
 - 2. Outside-Air Temperature Indication.
 - 3. Cooling or Heating/Economizer System Mode Indication.
 - 4. Zone temperature indication and setpoints.
 - 5. Alarms (as recommended by T.C.C.).

PART 2 - CONTROL SEQUENCES

2.1 COOLING ONLY PACKAGED ROOFTOP UNIT WITH DUCT MOUNTED HOT WATER REHEAT COILS CONTROL (RTU-1, HC-1A, HC-1B, EF-20)

- A. Occupied and Unoccupied cycles of operation shall be determined by the DDC controller serving this unit. During occupied operation, the RTU supply fan will run continuously with the outside air damper open to its minimum open setting (adjustable). The EF-20 speed shall track with outside air damper position, this may be overridden by a manual speed control switch in Wrestling Storage. A space temperature sensor will maintain the space temperature at its setpoint by modulating the outdoor air dampers in sequence with the DX cooling and duct mounted hot mounted hot water coils. Upon a call for cooling in economizer conditions, the outside air dampers will be modulated open beyond their minimum setting, the return air dampers will be modulated closed. If the economizer cannot satisfy the cooling requirements, the DX cooling will be modulated. The outdoor air damper position, and supply fan speed will be balanced to maintain a slight positive pressure in the space relative to outdoors (0.05" w.c., adj., BAS to monitor). A mixed air low limit sensor will prevent the mixed air temperature from dropping below 50F (adj.) in cooling mode. An outdoor air sensor will override the outdoor air damper back

to minimum setting whenever the outdoor air temperature is above 60F (adj.). Upon a call for heating, the 2-way modulating hot water valves in the duct mounted hot water coils shall modulate open to maintain space temperature.

- B. Minimum Outside Air Ventilation - Carbon Dioxide (CO₂) Control: When in the occupied mode, the controller shall measure the zone CO₂ levels and override normal damper operation to maintain a CO₂ setpoint of 800 ppm (adj.). When zone CO₂ levels are at 800 ppm or below, the outside air damper shall be closed. When CO₂ levels are between 800 ppm and 1000 ppm, the outside air damper shall linearly modulate open, from closed at 800 ppm to scheduled minimum value at 1000 ppm. When CO₂ levels are above 1000ppm, the outside air damper shall be set at its scheduled minimum values.
- C. During Unoccupied operation the RTU supply fan will be off, the outdoor air dampers will be closed. During unoccupied operation, if the space temperature rises above 75 deg F (adj) the supply fan and DX cooling will be enabled with outside air damper closed to cool the space to setpoint. If the space temperature falls below 60 deg f (adj) the supply fan shall be enabled with the outside air damper closed, and the hot water valves for the duct mounted heating coils shall modulate to supply 90 deg F air to the space to maintain setpoint.
- D. Safeties: The following device(s) will close the outdoor air damper, modulate each hot water reheat coil valve to fully open position, and send an alarm to the workstation and printer when activated: Reheat Coil low limit.
- E. Operator's Workstation shall display the following:
 - 1. Equipment Designation/Label.
 - 2. System Occupied/Unoccupied Mode.
 - 3. System On-Off Indication.
 - 4. Room/Area Served.
 - 5. Room/Area Temperature.
 - 6. Room/Area Temperature Setpoint, Occupied.
 - 7. Room/Area Temperature Setpoint, Unoccupied.
 - 8. Building Pressure Sensor Indication and Location.
 - 9. Outside Air Damper Position.
 - 10. Outside Air Temperature and Relative Humidity.
 - 11. Return air damper position.
 - 12. Return Air CO₂ Indication.
 - 13. Return Air Temperature Indication.
 - 14. Return Air Relative Humidity% Indication.
 - 15. Mixed Air Temperature Indication.
 - 16. Mixed Air Relative Humidity Indication.
 - 17. Economizer Mixed Air Temperature Set-Point.
 - 18. Economizer Status.
 - 19. Compressor On-Off Indication.
 - 20. Compressor Capacity Modulation (0-100%).
 - 21. Compressor Run-Time Hours.
 - 22. Supply Fan Status.
 - 23. Supply Fan Speed.
 - 24. Supply Fan On-Off Command.
 - 25. Hot Water Heating Coil HC-1A valve position (0-100%).
 - 26. Hot Water Heating Coil HC-1A valve command.
 - 27. Hot Water Heating Coil HC-1B valve position (0-100%).
 - 28. Hot Water Heating Coil HC-1B valve command.
 - 29. EF-20 Status.
 - 30. EF-20 Speed.
 - 31. EF-20 On-Off Command.
 - 32. Alarm Status (Alarms as Recommended by T.C.)

2.2 FAN COIL UNIT WITH DX COOLING, AIR-COOLED CONDENSING UNIT, AND DUCT MOUNTED HOT WATER HEATING COIL CONTROL

- A. Occupied Operation:
1. While the space is occupied, the fan-coil fan operates continuously supplying a constant volume of supply air.
 2. While there is no call for heating or cooling from any space thermostats, the fan coil fan shall run continuously with the outside air damper open to provide minimum ventilation air CFM to spaces. The DX cooling coil shall be enabled, and hot water reheat coil shall be modulated as necessary to discharge room neutral temperature air.
 3. Minimum Outside Air Ventilation - Carbon Dioxide (CO₂) Control: When in the occupied mode, the controller shall measure the CO₂ levels in the return air duct and override normal damper operation to maintain a CO₂ setpoint of 800 ppm (adj.). When return air CO₂ levels are at 800 ppm or below, the outside air damper shall be closed. When CO₂ levels are between 800 ppm and 1000 ppm, the outside air damper shall linearly modulate open, from closed at 800 ppm to scheduled minimum value at 1000 ppm. When CO₂ levels are above 1000ppm, the outside air damper shall be set at the scheduled minimum value. CO₂ sensor to be mounted in the return air duct.
 4. Cooling Mode:
 - a. When outside air is less than or equal to 55 F (economizer):
 - 1) On an increase in space temperature, modulate the outside air damper open past the ventilation minimum to increase the flow of cool outside air from the louver to the fan coil mixing box. Modulate the return air damper/outside air damper proportionally to satisfy room cooling requirements.
 - 2) On a decrease in space temperature, modulate the outside air damper closed to decrease the flow of cool outside air to the fan coil mixing box back to the ventilation minimum CFM. The 2-way modulating control valve on the reheat coil shall be proportionally modulated to maintain room neutral temperature discharge.
 - b. When outside air is greater than 55 F:
 - 1) On an increase in space temperature, enable DX cooling on condensing unit.
 - 2) On a decrease in space temperature past setpoint, disable DX cooling on condensing unit. The 2-way modulating control valve on the reheat coil shall be proportionally modulated to maintain room neutral temperature discharge if necessary.
 5. Heating Mode:
 - a. On a decrease in space temperature, the 2-way modulating control valve on the reheat coil shall be modulated to increase the discharge air temperature proportionally to the room demand.
 - b. On an increase in space temperature, modulate close the 2-way modulating control valve on the reheat coil as necessary.
- B. Unoccupied mode:
1. While the space is unoccupied, the fan coil fan is disabled, and the outside air damper is closed. The fan is only enabled to supply a constant volume of supply air when there is a call for heating or cooling. During unoccupied operation, the outside air damper shall remain fully closed.
 2. Heating Mode:
 - a. On a decrease in space temperature below unoccupied setpoint (60F, adj), the fan is enabled, and the 2-way modulating control valve on the reheat coil is modulated to increase the discharge air temperature to 90F, adj. This same cycle will take place during cold weather on morning warm up except that the unit will operate in the heating mode with the outside air dampers closed until the return air temperature reaches 68F (adj.).
 3. Cooling Mode:

- a. On an increase in space temperature above unoccupied setpoint (78F, adj), the fan and condensing unit are enabled to maintain the space temperature.
- C. Operator Workstation: Display the following data:
1. Room/area served.
 2. Room occupied/unoccupied.
 3. Room temperature.
 4. Room temperature set point, occupied.
 5. Room temperature set point, unoccupied.
 6. Heating Occupied/Unoccupied Setpoints
 7. Cooling Occupied/Unoccupied Setpoints
 8. Mode indication, heating/cooling/satisfied.
 9. Return Air Damper Position (% open).
 10. Outside Air Damper Position (% open).
 11. Return Air CO2 indication.
 12. Return Air CO2 setpoint.
 13. Return Air relative humidity indication.
 14. Return Air temperature.
 15. Outside Air temperature.
 16. Economizer Status.
 17. Heating Coil Water valve position (% open).
 18. Heating Coil Leaving Air Temperature.
 19. Heating Coil Leaving Air Temperature Setpoint.
 20. Condensing Unit DX Cooling Enabled/Disabled
 21. Condensing Unit Stage Enabled/Disabled
 22. Condensing Unit Run Time (hours)
 23. Alarm Status (alarms as recommended by T.C.C.).

2.3 EXG AHU-2 AIR HANDLING UNIT WITH EXISTING CONDENSING UNIT – VAV APPLICATION

- A. The existing sequences shall remain as-is, except where modifications are necessary to complete the proposed addition of (3) VAV's to the existing system.
- B. TC shall provide the existing sequence and flow diagram as part of their submittal with any modifications for the proposed work.

2.4 SHUTOFF VARIABLE AIR VOLUME (VAV's) TERMINAL UNIT CONTROL

- A. VAV UNITS WITH HYDRONIC CONTROLS
 1. The VAVs will be controlled by the space temperature sensor to vary the primary air flow to the space to provide cooling or heating whenever the air handling unit is operational. On a call for cooling in the space, the primary damper will be modulated open beyond the minimum position to meet the cooling demand. On a call for heating in the space the primary air damper will be modulated to the heating position (adj.) as scheduled and the HW 2-way modulating control valve will modulate open as necessary (0-100%) to provide heat to the space. 2-way valve normal (fail) to last position.
 - a. In heating mode, the primary air damper will be modulated beyond the heating position to maintain a discharge air temperature no higher than 95 deg F (adj).
 2. All VAV Units shall operate in either the occupied or unoccupied mode and the space sensor with adjustable setpoint shall have an over-ride button on the face to return the terminal unit to its occupied mode of operation if the terminal unit is in "Unoccupied" mode.
- B. Operator's Workstation shall display the following:
 1. Equipment Designation/Label.
 2. Room/area served.
 3. Room occupied/unoccupied.
 4. Room temperature.
 5. Room temperature set point, occupied.

6. Room temperature set point, unoccupied.
7. Actual Air Temperature Delivered to the VAV.
8. Mode indication, heating/cooling/satisfied.
9. Entering Hot Water Temperature
10. 2-way Modulating hot water valve position as percent open.
11. Air-damper position as percent open
12. Supply airflow rate, target.
13. Supply airflow rate, actual.
14. VAV Discharge Air Temperature.
15. Alarm Status (Alarms as recommended by T.C.C.).

2.5 CABINET UNIT HEATER CONTROL (CUH-X)

- A. Cabinet unit heaters to have 3-way 2-position temperature control valve with normal/fail position to flow through coil. Normal/fail to last position shall not be acceptable.
- B. The unit heaters will be controlled by the space temperature sensor. On a call for heat, the first stage of heat shall be water flow through the coil at 100% flow with the fan disabled. If the room temperature drops more than 1 degree below setpoint after first stage heating, the fan will be enabled, and hot water valve will modulate as necessary to meet the heating demand. The BAS will prevent the fan from operating unless 100 degree F. (adj.) hot water is available. The modulating control valve shall have normal (fail) position as flowing through heating coil, fail to last position shall not be acceptable.
- C. OPERATOR WORKSTATION
 1. Display the following data:
 - a. Equipment Designation.
 - b. Room/area served.
 - c. Room occupied/unoccupied.
 - d. Room temperature.
 - e. Room temperature set point.
 - f. Hot water valve position as percent open to coil.
 - g. Discharge Air Temperature.
 - h. Alarm Status (alarms as recommended by T.C.C.).

2.6 INFLOOR HEAT & CIRCULATOR (CP-3) CONTROL

- A. The infloor heat Zone 1 in Locker Room 506 will be controlled by a slab stat & space temperature sensor.
- B. The infloor heat Zone 2 in Locker Room 505 will be controlled by a slab stat & space temperature sensor.
- C. The infloor heat Zone 3 in Girls Locker Room 508 will be controlled by a slab stat & space temperature sensor.
- D. The infloor heat Zone 4 in Boys Locker Room 509 will be controlled by a slab stat & space temperature sensor.
- E. The infloor heat Zone 5A in Corridor 500B will be controlled by a slab stat & space temperature sensor. The infloor will be supplemental heat to fan coil FC-1.
- F. The infloor heat Zones 6A & 6B in MEP/BOH 510A & Storage 510B will be controlled by a slab stat & space temperature sensor located in MEP/BOH 510A.
- G. All manifolds and 3-way modulating valves are located in MEP/BOH 510A.
 1. On a call for heat by any the slab stat or air stat, the respective 3-way 2-position zone valve shall open to allow flow through the in-floor zone, the infloor heat circulator CP-3 shall run and the 3-way modulating temperature control valve shall modulate as necessary to inject heat to the in-floor system to meet the desired infloor loop setpoint of 130F (adj.).

2. CP-3 shall modulate speed to maintain differential pressure setpoint in the infloor heat system.
3. Each zone valve shall modulate open on a call for heat from its respective slab or air stat.
4. Operator Workstation: Display the following data:
 - a. Outside Air Temperature.
 - b. Zone # Designation.
 - c. Room/area served.
 - d. Slab temperature indication.
 - e. Slab temperature setpoint.
 - f. Room temperature indication.
 - g. Room temperature setpoint.
 - h. 3-way modulating hot water injection valve position as percent open (%injecting heat into loop).
 - i. Infloor Heat Circulator CP-3 On-Off Indication.
 - j. Infloor Heat Circulator CP-3 Speed (as %).
 - k. Infloor Heat System Differential Pressure Indication.
 - l. Infloor Heat System Differential Pressure Setpoint.
 - m. Infloor Heat HWS Temperature Indication.
 - n. Infloor Heat HWS Temperature Setpoint.
 - o. HWS Temperature available from central plant.
 - p. Zone-1 3-way valve position as percent open (flow through loop)
 - q. Zone-2 3-way valve position as percent open (flow through loop)
 - r. Zone-3 3-way valve position as percent open (flow through loop)
 - s. Zone-4 3-way valve position as percent open (flow through loop)
 - t. Zone-5A 3-way valve position as percent open (flow through loop)
 - u. Zone-6A/B 3-way valve position as percent open (flow through loop)
 - v. Alarm status (alarms as recommended by TC).

2.7 INFLOOR HEAT, ICE MELT & CIRCULATOR (CP-2, HX-1) CONTROL

- A. When the slab temperature is 38F or below, CP-2 shall be enabled, and will circulate heating water through ice melt Zones continuously. Disable CP-2 when slab stat reaches 40F.
 1. A 2-way 2-position temperature control valve shall modulate to inject heat into the infloor/ice melt loop to maintain 130F loop temperature through the heat exchanger HX-1. Normal/Fail position to circulate water through HX-1 (see detail). If Zone 5B is not calling for heat, its 3-way 2-position temperature control valve shall be positioned to bypass Zone 5B manifold.
- B. The infloor heat Zone 5B in Corridor 500A will be controlled by a slab stat & space temperature sensor. The infloor will be supplemental heat to VAV-13.
 1. On a call for heat by either the slab stat or air stat, the infloor heat circulator CP-2 shall run, the 3-way modulating temperature control valve shall modulate as necessary to meet the desired infloor loop setpoint of 130F (adj.), and the 3-way 2-position temperature control valve shall be opened to flow through Zone 5B Manifold. Normal/fail position for 3-way 2-position temperature control valve to circulate water through Zone 5B Manifold.
 2. Operator Workstation: Display the following data:
 - a. Outside Air Temperature.
 - b. Zone # Designation.
 - c. Room/area served.
 - d. Slab temperature indication.
 - e. Slab temperature setpoint.
 - f. Room temperature indication.
 - g. Room temperature setpoint.
 - h. 2-way 2-position hot water injection valve position as percent open (%injecting heat into HX-1).
 - i. 3-way 2-position Zone 5B Manifold control valve position as percent open (% of flow through manifold).
 - j. Zone 5B Slab temperature indication.

- k. Zone 5B Slab temperature setpoint.
- l. Ice Melt Slab temperature indication.
- m. Ice Melt Slab temperature setpoint.
- n. Infloor Heat Circulator CP-2 On-Off Indication.
- o. Ice Melt System Pressure
- p. Ice Melt System Return Temperature Indication.
- q. Ice Melt System Supply Temperature Indication.
- r. Ice Melt/Infloor Heating Water Temperature Setpoint.
- s. Ice Melt System Pressure Low Alarm (less than 5 psig adj.)
- t. Alarm status (alarms as recommended by TC).

2.8 2010 & 2025 ADDITION HEATING WATER LOOP PUMPS (HWP-1 & HWP-2) CONTROL:

- A. The primary hot water heating pump shall be started as per the existing sequences. The BAS shall modulate the variable frequency drive for the primary pump to maintain the desired system differential pressure according to a differential pressure sensor located as directed by the Engineer. Final differential pressure setpoint shall be coordinated with Balancing Contractor.
- B. Each of the two hot water heating pumps shall have a current switch or differential pressure switch to prove pump operation.
- C. Primary pump shall be enabled and its variable frequency drive shall be modulated by the BAS to maintain the desired system differential pressure. The minimum speed of the pumps shall be 20% (adj.), or value recommended by the pump and/or variable frequency drive manufacturer. The BAS Contractor shall provide the necessary programming to alternate the pumps. Rotate primary/backup pumps per the existing sequences.
- D. The backup pump is enabled if the lead pump fails to prove operation or when the system differential pressure set point is not maintained with the primary pump for a minimum of 5 minutes (adj.). If both primary and backup pumps are operating at minimum speed, and differential pressure setpoint is exceeded by 2 psi for a minimum of 5 minutes (adj.), the stand-by pump shall be disabled.
- E. Graphic Operator's Workstation shall display the following (each water temp point represents a temperature sensor well to be installed in the heating system piping, coordinate with PC to install wells within 12" of thermometer wells by PC):
 - 1. Equipment Designation.
 - 2. Auto or Manual Override indication.
 - 3. Differential Pressure Set-point.
 - 4. Differential Pressure Actual.
 - 5. Heating Water System Pressure.
 - 6. HWP-1 on-off indication.
 - 7. HWP-1 VFD speed indication.
 - 8. HWP-2 on-off indication.
 - 9. HWP-2 VFD speed indication.
 - 10. HWP-1 VFD Fault.
 - 11. HWP-2 VFD Fault.
 - 12. Heating Water Supply Temperature to Addition.
 - 13. Heating Water Return Temp from Addition.
 - 14. Outside-Air Temperature Indication.
 - 15. Alarm Status (alarms as recommended by T.C.C.).

2.9 EXHAUST FAN CONTROL (EF-X)

- A. See electrical plans for J-Box locations provided by EC for use by TC for relays.
- B. EF-16 – Girls Locker Room 508, Boys Locker Room 509, Storage 511B Exhaust – shall operate during occupied hours as determined by the BAS System.
 - 1. D.D.C. controls shall prevent fan operation during Unoccupied Operation (as determined by the BAS).

- C. EF-17 –Locker Room 505, Locker Room 506, MEP/BOH 507 Exhaust – shall operate during occupied hours as determined by the BAS System.
 - 1. D.D.C. controls shall prevent fan operation during Unoccupied Operation (as determined by the BAS).
- D. EF-18 – MEP/BOH 510A Exhaust – shall operate with the lights by EC.
 - 1. D.D.C. controls shall monitor operation.
- E. EF-19 – Storage 510B Exhaust – shall operate with the lights by EC.
 - 1. D.D.C. controls shall monitor operation.
- F. EF-20 – Wrestling 511 Relief/Exhaust – shall operate during occupied hours as determined by the BAS System. EF-20 speed shall track with RTU-1 outside air damper position.
 - 1. EF-20 shall also be enabled and speed controlled by manual speed controller in wrestling storage.
 - 2. D.D.C. controls shall prevent fan operation during Unoccupied Operation (as determined by the BAS).

2.10 DOMESTIC HOT WATER DIGITAL WATER TEMPERING SYSTEM

- A. The BAS shall integrate with the domestic hot water digital water tempering system. The BAS shall modulate the digital water tempering system mixing valve to maintain a leaving hot water temperature of 120F (sensor shall be integral to digital water tempering system), with water heater set to 140F (no DDC control of water heaters, only monitoring for combustion air).
- B. BAS to enable CP-1A & CP-1B when domestic hot water return temperatures are at 115F (adj.) or below, while the building is in occupied mode. Disable CP-1A & CP-1B when building is unoccupied.
- C. Operator's workstation to display the following:
 - 1. Mixed outlet water temperature in degrees F
 - 2. Mixed outlet water temperature setpoint in degrees F.
 - 3. Water Heater 1 Outlet water temperature in degrees F.
 - 4. Water Heater 2 Outlet water temperature in degrees F.
 - 5. Water Heater 1 Status.
 - 6. Water Heater 2 Status.
 - 7. Actuator override.
 - 8. Mixing Valve High/low temperature alarm.
 - 9. CP-1A Status.
 - 10. CP-1B Status.
 - 11. Elementary Return water temperature.
 - 12. Proposed Addition Return water temperature.
 - 13. Return water temperature setpoint (115F, adj).
 - 14. Combustion air damper position (Actual).

2.11 COMBUSTION AIR INTAKE MOTORIZED DAMPERS

- A. Normally closed 24V water heater combustion air control damper actuator by TC. TC to wire such that damper will open with water heater operation, TC to monitor damper call and status with end switch.
- B. TC to open combustion air damper with water heater operation. When there is a call for heat, TC shall open damper to 100% and prove position prior to enabling the water heater. If damper fails to prove open, TC to alarm.
- C. Graphic Operator's Workstation shall display the following:
 - 1. Equipment Designation/Label.
 - 2. Outside-Air Temperature Indication.
 - 3. WH-1 Status.
 - 4. WH-2 Status.
 - 5. Combustion Air Damper Position (Setpoint).
 - 6. Combustion Air Damper Position (Actual).
 - 7. Alarm Status (alarms as recommended by T.C.).

2.12 TRAINING

- A. The Temperature Control Contractor shall provide (8) hours of training to the owner's representative.

2.13 WARRANTY

- A. The entire control system shall be warranted for a period of 1 year from the date of beneficial use of the system.

PART 3 - PRODUCTS

3.1 VARIABLE FREQUENCY DRIVES

A. WARRANTY

- 1. Warranty shall be 24 months from the date of start-up, not to exceed 30 months from the date of shipment.
- 2. Warranty shall include all parts.

B. GENERAL

- 1. VFD shall be current rated at 8 kHz carrier frequency for VFD's 1-75 HP and 4 kHz for VFD's 100-400 HP. All HP ratings shall meet or exceed Table 430-150 of the National Electric Code. Three Phase Motor Full Load Currents, HP, Maximum Current, and Rated Voltage shall appear on the drive nameplate.
- 2. VFD shall not generate damaging voltage pulses at the motor terminals when applied within 500 feet of each other. Both Drive and Motor shall comply with NEMA MG1 section 30.40.4.2 which specifies these limits at a maximum peak voltage of 1600 Volts and a minimum rise time of .1 microseconds.

C. CODES/STANDARDS

- 1. VFD and options shall be c UL-508 listed.
- 2. NEMA 12 enclosed VFD shall be UL-1995 approved for mounting in conditioned air ducts and plenums.
- 3. The drive and options shall comply with the applicable requirement of the latest standards of ANSI, NEMA, National Electric Code NEC, NEPU-70, IEEE 519-1992, FCC Part 15 Subpart J, CE 96.

D. QUALITY ASSURANCE

- 1. Every VFD shall be functionally tested under motor load. During this load test the VFD shall be monitored for correct phase current, Phase voltages, and motor speed. Correct Current Limit operation shall be verified by simulating a motor overload.
- 2. Verification of proper factory presets by scrolling through all parameters shall be performed to ensure proper microprocessor settings. The computer port should also verify that the proper factory settings are loaded correctly in the drive.
- 3. All options shall be functionally tested. Proper heater coil installation in motor overload, if supplied, shall be verified.

E. SERVICE

- 1. Factory authorized representative start-up shall be included for each VFD provided.
- 2. Service engineers shall be employed by the manufacturer or be certified by the manufacturer and provide start-up service including physical inspection of drive and connected wiring and final adjustments to meet specified performance requirements.

F. DRIVE FUNCTIONS

- 1. An electronic overload circuit designed to protect an AC motor operated by the VFD output from extended overload operation on an inverse time basis. This Electronic overload shall be UL® and NEC recognized as adequate motor protection. No additional hardware such as motor overload relays or motor thermostats shall be required.
- 2. An LED display mounted on the door of the cabinet that digitally indicates:
 - a. Frequency output
 - b. Voltage output
 - c. Current output
 - d. Motor RPM

- e. Input kW
 - f. Elapsed Time
 - g. Time Stamped Fault Indication
 - h. DC Bus Volts
3. The VFD shall have the capability of riding through power dips up to 10 seconds without a controller trip depending on load and operating condition. In this extended ride through, the drive shall use the energy generated by the rotating fan as a power source for all electronic circuits.
 4. RS232 Port and Windows based software for Configuration, Control, and Monitoring.
 5. An isolated 0-20mA, 4-20mA or 0-4, 0-8, 0-10 volt analog speed input follower.
 6. An isolated 0-10 V or 4-20 mA output signal proportional to speed or load.
- G. PROTECTIVE CIRCUITS AND FEATURES
1. Motor current exceeds 200% of drive continuous current rating.
 2. Output phase-to-phase short circuit condition.
 3. Total ground fault under any operating condition.
 4. High input line voltage.
 5. Low input line voltage.
 6. Loss of input or output phase.
 7. External fault. (This protective circuit shall permit wiring of remote N.C. safety contact to shut down the drive). User supplied end switches, thermal switches, fire-stats, freeze-stats inputs will be connected to this VFD supplied circuit.
 8. Metal oxide varistors for surge suppression shall be provided at the VFD input terminals.
- H. GENERAL OPTIONS AND MODIFICATIONS
1. Input line fuses shall provide protection for the input rectification circuit using Class J fuses with interrupting rating of 200,000 AIC. The series interrupting rating of the VFD and fuses shall be a minimum of 30,000 AIC and shall be stated in the VFD Instruction Manual as required by UL
 2. A main input disconnect shall mount within the standard NEMA 1 or NEMA 12 enclosure for positive power disconnect of the VFD. It shall have the capability for door padlocking.
 3. A three phase 3% impedance Input Line Reactor shall be provided to minimize drive harmonics on the AC line and protect the drive from damaging electrical system transients.
- I. INSTALLATION
1. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the AFD's in accordance to the manufacturer's recommendation as outlined in the instruction manual.
 2. The electrical contractor shall complete power wiring. The contractor shall install the AFD's in accordance to the manufacturer's recommendation as outlined in the instruction manual.
- J. TRAINING
1. The contractor shall provide a training session for owner's representatives
 2. The training shall be conducted by the manufacturer's authorized representative and shall include:
 3. Instructions on the proper operation of the equipment.
 4. Instructions on the proper maintenance of the equipment.

PART 4 - EXECUTION

4.1 INSTALLATION

- A. All devices in mechanical rooms shall be panel mounted whenever possible. Wiring to remote mounted devices in mechanical rooms and inaccessible spaces shall be run in conduit. Wiring in accessible ceilings may be run with plenum rated cable providing it is securely fastened to the structural members at 4' intervals. In general, all wiring in conjunction with the automatic temperature control system shall be furnished by the Temperature Control Contractor under this section of the specifications in accordance with Division 26 of the specifications.

- B. All automatic valves shall be furnished by the Temperature Control Contractor and installed under his supervision by the Heating Contractor. All automatic dampers, not furnished with the equipment, shall be furnished by the Temperature Control Contractor and installed under his supervision by the Sheet Metal Contractor.

4.2 PROJECT COMPLETION AND ACCEPTANCE

- A. Upon completion of this project, it will be this Contractors responsibility to insure that the control system is functioning properly. The Contractor shall also insure that the control diagrams for the project are brought up to date and that they reflect the control system "as built". These control diagrams and screen shots of the various screens of the color graphics system shall be included in the Operation and Maintenance Manuals, which shall be turned over to the Owner following the acceptance of the above procedure by the A/E.

4.3 ON-SITE ASSISTANCE

- A. **ON-SITE Adjustments: Within one year of date of Substantial Completion, provide 4 hours EVERY MONTH to adjust and calibrate components and to assist Owner's personnel in making program changes and in adjusting sensors and controls to suit actual conditions and improve efficiency. Certain off-site adjustments may be acceptable if owner and engineer approved.**

END OF SECTION 23 0900

**SECTION 23 2113
HYDRONIC PIPING SYSTEMS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The work in this specification and the accompanying drawings consists of performing all labor and furnishing of all material and equipment necessary to install complete systems listed below, including minor items obviously necessary for complete and operating systems. Piping materials and equipment specified in this Section include the following:
 - 1. All new heating water hydronic piping systems
 - 2. All new chilled water hydronic piping systems
 - 3. In Floor heating circulator pumps
 - 4. Cabinet Unit Heaters
 - 5. Cooling Condensate Piping
 - 6. Pipes, fittings, and specialties.
 - 7. Special-duty valves.
 - 8. Meters and gages.
 - 9. Hydronic specialties.
- B. See Division 23 Section "Basic HVAC Materials and Methods" for general piping installation requirements.
- C. Also included is the work involved to remove existing associated equipment, remodeling of existing systems, including connections between new and existing systems.
- D. Hydronics contractor to be responsible for all condensate piping.

1.3 SUBMITTALS

- A. Shop Drawings: Shop drawings as specified in Section 230500 shall include the following:
 - 1. Hydronic Specialties
 - 2. In Floor Heat Circulator Pumps
 - 3. Brazed Plate Heat Exchanger
 - 4. Compression Style Expansion Tanks
 - 5. Horizontal Bladder Expansion Tank
 - 6. Inline Air Separator
 - 7. Heating System Vertical Inline Pumps
 - 8. Heating Water Hydronic Pipe, Valves, and Fittings
 - 9. Chilled Water Hydronic Pipe, Valves, and Fittings
 - 10. Cooling Condensate Piping
 - 11. Flow Control and Strainer Valves
 - 12. Cabinet Unit Heaters
 - 13. Heating System Propylene Glycol – 40% Concentration
 - 14. Ice Melt Heating System Propylene Glycol – 50% Concentration
 - 15. Chilled Water System Ethylene Glycol – 35% Concentration
 - 16. Hydronic Solution Analysis & Water-Treatment Program: After proposed work is complete, provide a complete analysis to confirm proper glycol % and treatment. If solution analysis is not satisfactory, make adjustments as recommended by glycol supplier and retest until analysis is satisfactory.
 - 17. Spare Parts

- B. Product Data: For each type of special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing for diverting fittings, calibrated balancing valves, and automatic flow-control valves.
- C. Shop Drawings: Detail fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure.
- D. Detail location of anchors, alignment guides, and expansion joints and loops.
- E. Field quality-control test reports.
- F. Operation and maintenance data.

1.4 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work shall be as specified in Section 23 0510.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- C. Uponor PEX-a tube and fitting systems must be installed by a trained installer. Installer must be able to provide verification from the manufacturer that the training has been completed.

1.6 COORDINATION

- A. Coordinate pipe sleeve installations for foundation wall penetrations.
- B. Coordinate layout and installation of piping with equipment and with other installations.
- C. Coordinate pipe fitting pressure classes with products specified in related Sections.
- D. Coordinate with requirements for firestopping for fire and smoke wall and floor assemblies.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS

- A. Copper Tube and Fittings:
 - 1. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
 - 2. Annealed-Temper Copper Tubing: ASTM B 88, Type K.
 - 3. Wrought-Copper Fittings: ASME B16.22.
 - 4. Wrought-Copper Unions: ASME B16.22.
 - 5. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.
 - 6. At the contractor's option, Nibco Press System or Viega may be used on domestic or hydronic water in lieu of soldered copper fittings. Fittings shall be suitable for working pressures to 200 psig CWP and maximum operating temperatures to +230 degrees F. The fitting manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of tools, marking and preparation of pipe, and installation of products. The representative shall periodically visit the job site and review contractor's installation and verify the correct procedures are being followed.
- B. Steel Pipe and Fittings:
 - 1. Steel Pipe, NPS 2 and Smaller: ASTM A 53, Type S (seamless), Grade A, Schedule 40, black steel, plain ends.
 - 2. Steel Pipe, NPS 2-1/2 through NPS 12: ASTM A 53, Type E (electric-resistance welded), Grade A, Schedule 40, black steel, plain ends.
 - 3. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, Schedule 40, black steel; seamless for NPS 2 and smaller and electric-resistance welded for NPS 2-1/2 and larger.
 - 4. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250.
 - 5. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300.

6. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.
 7. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, 125, and 250; raised ground face, and bolt holes spot faced.
 8. Wrought-Steel Fittings: ASTM A 234 (ASTM A 234M), Standard Weight.
 9. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
 - a. Material Group: 1.1.
 - b. End Connections: Butt welding.
 - c. Facings: Raised face.
 10. Grooved Mechanical-Joint Fittings: ASTM A 536, Grade 65-45-12 ductile iron; ASTM A 47, Grade 32510 malleable iron; ASTM A 53, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.
 11. Grooved Mechanical-Joint Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings.
 12. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body, steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 220 deg. F and pressures up to 150 psig.
 13. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.
- C. Polyethylene PEX Pipe and Fittings:
1. 2" and smaller Cross linked Polyethylene Uponor PEX a Pipe: ASTM 877, SDR 9 with oxygen diffusion penetration per DIN 4726. Fittings consisting of Engineered polymer ASTM F 1960 Cold expansion fitting with reinforcing ring. Two piece compression fitting ASTM 877 with cold expansion fitting with reinforcing ring.
 2. Groove Fittings for PEX Tube: One-piece brass F1960 cold-expansion fitting and groove fitting CSAB242-05.

2.2 COOLING CONDENSATE DRAIN PIPING

- A. Above Grade: Drain piping shall be type "M" copper, ASTM B 88, with cast-copper solder-joint drainage fittings, ANSI B 16.23, or wrought-copper solder joint, ANSI B 16.29, non-corrosive past flux and 50/50 tin-lead solder ASTM B 32.
1. All exposed condensate piping routed above grade must be routed in copper.
 2. Where routed through raised floor, contractor may use schedule 40 PVC or ABS, solvent weld fittings.
- B. Below Grade: Schedule 40 PVC, solvent weld fittings.

2.3 VALVES

- A. General-Duty Valves, NPS 2 and Smaller: Bronze body, ball type, threaded ends, unless otherwise indicated. Valve pressure and temperature ratings not less than indicated and as required for system pressures and temperatures. Valve size shall be the same size as upstream pipe, unless otherwise indicated. Quarter-turn lever handle valve actuators. Extended valve stems on insulated valves.
- B. Safety Valves: Diaphragm-operated, bronze or brass body with brass and rubber, wetted, internal working parts; shall suit system pressure and heat capacity and shall comply with the ASME Boiler and Pressure Vessel Code, Section IV.
- C. Pump Discharge Valves: 175-psig maximum working pressure, 250 deg F maximum operating temperature, cast-iron or ductile iron body, replaceable bronze disc with EPDM seat insert, bronze seat, stainless steel stem and spring, and "Teflon" packing. Valves shall have NPT,

grooved or flanged connections and straight or angle pattern. Features shall include non-slam check valve with spring-loaded weighted disc, pressure taps, and calibrated adjustment feature to permit regulation of pump discharge flow, shutoff and valve design to permit repacking under full system pressure.

2.4 METERS AND GAGES

- A. Liquid-In-Glass Thermometers
 - 1. Description: ASTM E 1.
 - 2. Range: Temperature range of: 40 to 240 deg F on heating water & condenser water systems, and 0 to 160 deg F on geothermal, evaporator, and chilled water systems, with 2-degree scale divisions (minus 18 to plus 70 deg C, with 1-degree scale divisions). Accuracy shall be plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.
 - 3. Case: Die cast and aluminum finished in baked-epoxy enamel, glass front, spring secured, 9 inches long.
 - 4. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
 - 5. Tube: Red or blue reading, organic-liquid filled with magnifying lens.
 - 6. Scale: Satin-faced nonreflective aluminum with permanently etched markings.
 - 7. Stem: Copper-plated steel, aluminum, or brass for separable socket; of length to suit installation.
- B. Bimetal Dial Thermometers
 - 1. ASME B40.3; direct-mounting, universal-angle dial type.
 - 2. Case: Stainless steel with 5-inch diameter lens.
 - 3. Adjustable Joint: Finish to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.
 - 4. Element: Bimetal coil.
 - 5. Scale: Satin-faced nonreflective aluminum with permanently etched markings.
 - 6. Stem: Stainless steel for separable socket, of length to suit installation.
- C. Thermometer Wells
 - 1. Description: Fitting with protective well for installation in threaded pipe fitting to hold test thermometer.
 - 2. Material: Brass, for use in copper piping.
 - 3. Material: Stainless steel, for use in steel piping.
 - 4. Extension-Neck Length: Nominal thickness of 2 inches, but not less than thickness of insulation. Omit extension neck for wells for piping not insulated.
 - 5. Insertion Length: To extend 2 inches into pipe.
 - 6. Cap: Threaded, with chain permanently fastened to socket.
- D. Pressure Gages
 - 1. Description: ASME B40.1, phosphor-bronze bourdon-tube type with bottom connection; dry type, unless liquid-filled-case type is indicated.
 - 2. Case: Drawn steel, brass, or aluminum with 4 1/2" diameter, glass lens.
 - 3. Connector: Brass, NPS 1/4.
 - 4. Scale: White-coated aluminum with permanently etched markings
 - 5. Accuracy: Grade A, plus or minimum 1 percent of middle 50 percent of scale.
 - 6. Range: Comply with the following:
 - a. Fluids under Pressure: Two times the operating pressure.
- E. Pressure Gage Fittings
 - 1. Hydronic Indicator: Brass body with four inlets and valves by Flow Conditioning Corp. (314) 878-7898 or equal.

2. Valves: NPS ¼ brass or stainless-steel needle type
 3. Syphons: NPS ¼ coil of brass tubing with threaded ends.
 4. Snubbers: ASME B40.5, NPS ¼ brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.
- F. Test Plugs
1. Description: Nickel-plated, brass –body test plug in NPS ½ fitting.
 2. Body: Length as required to extend beyond insulation.
 3. Pressure Rating: 500 psig minimum.
 4. Core Inserts: Two self-sealing valves, suitable for inserting 1/8-inch OD probe from dial-type thermometer or pressure gage.
 5. Core Material for Air, Water, and Gas: 20 to 200 deg F (Minus 7 to plus 93 deg C), chlorosulfonated polyethylene synthetic rubber.
 6. Test-Plug Cap: Gasketed and threaded cap, with retention chain or strap.
 7. Test Kit: Pressure gage and adapted with probe, two bimetal dial thermometers, and carrying case.
- G. Pressure Gage and Thermometer Ranges: Approximately two times the system's operating conditions.

2.5 HYDRONIC SPECIALTIES

- A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig working pressure; 225 deg F operating temperature; manually operated 1/2" full port ball valve with gooseneck down; with NPS 1/2 discharge connection and NPS 1/2 inlet connection, and chained cap hose connection.
- B. Automatic Air Vent: Designed to vent automatically with float principle; bronze body and nonferrous internal parts; 150-psig working pressure; 240 deg F operating temperature; with NPS 1/4 discharge connection and NPS 1/2 inlet connection.
- C. Heating Loop Compression Style Expansion Tank: Welded carbon steel, rated for 125-psig working pressure and 240 deg F maximum operating temperature. Provide taps for pressure gage and air-charging fitting, and drain fitting. Support horizontal tank with supports from structure or wall. Fabricate and test tank with taps and supports, and label according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1. Provide with site glass and air control fitting.
- D. Ice Melt Heating Water Air Separator: Cast Iron; ASME constructed and labeled for 125-psig minimum working pressure and 300 deg F maximum operating temperature; in-line air separator designed to direct released to an air automatic air vent; inline inlet and outlet connections; threaded connections for all pipe sizes; threaded blow-down connection. Provide units in sizes for full-system flow capacity.
- E. Ice Melt Heating Water Bladder Style Expansion Tanks: Welded carbon steel, rated for 125-psig working pressure and 240 deg F maximum operating temperature. Provide taps for pressure gage and air-charging fitting, and drain fitting. Support vertical tanks with steel legs or base; support horizontal tanks with steel saddles. Fabricate and test tank with taps and supports, and label according to the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
- F. Y-Pattern Strainers: 125-psig working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2 and larger, threaded connections for NPS 2 and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection.
- G. Propylene Glycol: Industrially inhibited propylene glycol-based heat transfer fluid, Dowfrost HD with Inhibitor and Deionized Water (match existing), with the following features:
1. Industrially inhibited propylene glycol (phosphate-based).
 2. Dyed (bright yellow/green) to facilitate leak detection.

3. Easily analyzed for glycol concentration and inhibitor level.
 4. For systems containing more than 250 gallons of fluid, annual analysis must be provided free of charge by the fluid manufacturer.
 5. Fluid must pass ASTM D1384 (less than 0.5 mils penetration per year for all systems metals).
 6. Reserve alkalinity of the fluid must be at least 15 to provide long-term resistance to acidic pH.
- H. Ethylene Glycol: Industrially inhibited ethylene glycol-based heat transfer fluid, Dowtherm SR-1 with Inhibitor and Deionized Water (match existing), with the following features:
1. Industrially inhibited ethylene glycol (phosphate-based).
 2. Dyed (bright pink/red) to facilitate leak detection.
 3. Easily analyzed for glycol concentration and inhibitor level.
 4. For systems containing more than 250 gallons of fluid, annual analysis must be provided free of charge by the fluid manufacturer.
 5. Fluid must pass ASTM D1384 (less than 0.5 mils penetration per year for all systems metals).
 6. Reserve alkalinity of the fluid must be at least 15 to provide long-term resistance to acidic pH.

2.6 INFLOOR HEATING CIRCULATING PUMPS AND HEATING LOOP PUMPS

1. See Section 23 2123 – HVAC Hydronic Pumps for hydronic pump specifications.

2.7 HOT WATER CABINET UNIT HEATERS

- A. Furnish and install cabinet unit heater(s) where shown on the Drawings. Type, size, and performance shall be as tabulated in the schedule and on the drawings.
- B. Cabinet unit heater shall be factory-assembled of type as indicated on plans. The motors shall be 120 volt, single phase, multi-speed. Units shall be provided with lock type removable front access panel. Panel shall have custom color factory baked enamel finish, custom color to be selected by Architect.
- C. Make all hot water heating connections. This includes piping, valves, strainers, air vents, thermometers, immersion bulbs, flow switches, unions, etc.
- D. Controls, sensors, and control valve will be provided under Temperature Control Section.
- E. Power wiring will be provided under Division 26.
- F. Provide/install all accessories as scheduled or needed for proper operation

2.8 BRAZED PLATE-FRAME HEAT EXCHANGER

- A. General Description
 1. This section includes the design and installation requirements for brazed-plate heat exchangers.
- B. Submittals
 1. Product Data: Include rated capacities, operating characteristics, and furnished specialties and accessories.
 2. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection. Design Calculations: Calculate requirements for selecting seismic restraints and for designing bases. Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment.
 3. Certification of compliance with AHRI Standard 400.
 4. Manufacturer's Experience: Certificate of manufacturer's experience
 5. Source quality-control reports.
 6. Field quality-control reports.

7. Sample Warranty: For manufacturer's warranty.
- C. Quality Control
1. Factory Tests: Test and inspect heat exchangers in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1. Affix ASME International label.
 2. Hydrostatically test heat exchangers to minimum of one and one-half times pressure rating before shipment.
 3. Heat exchangers will be considered defective if they do not pass tests and inspections.
 4. Prepare test and inspection reports.
- D. Warranty
1. Manufacturer shall provide a limited "parts only" warranty for a period of 12 months from the date of equipment startup or 18 months from the date of original equipment shipment from the factory, whichever is less. Warranty shall cover material and workmanship that prove defective, within the specified warranty period, provided manufacturer's written instructions for Installation, Operation, and maintenance have been followed. Warranty excludes parts associated with routine maintenance.
- E. Manufacturer
1. Alfa Laval Inc.; or comparable product by one of the following:
 - a. Armstrong Fluid Technology.
 - b. Bell & Gossett
 - c. Polaris Heat Exchangers
 - d. Alpha Laval
 - e. Taco
 - f. Thrush
 - g. Or, prior engineer approved equal.
- F. Configuration
1. Brazed assembly, consisting of embossed or pressed stainless steel plates brazed together and two end plates, one with threaded nozzles and one with pattern-embossed plates. Floor-mounted heat exchangers must have factory-furnished integral legs with mounting feet.
- G. Construction
1. Fabricate and label heat exchangers to comply with ASME Boiler and Pressure Vessel Code, Section VIII, "Pressure Vessels," Division 1.
 2. End-Plate Material: Type 316 stainless steel.
 3. Threaded Nozzles: Type 316 stainless steel.
 4. Plate Material: Type 316 stainless steel.
 5. Brazing Material: Copper or stainless steel.
- H. Capacities and Characteristics
1. Provide unit with capacities and characteristics as scheduled on plans.
- I. Controls
1. Controls shall be field provided and field installed by others.
- J. Accessories
1. Unit shall be provided with custom steel supports for wall or structural steel mounting.
- K. Installation, Operation, and Maintenance
1. Installation, Operation, and Maintenance manual shall be supplied with the unit.
 2. Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation, and Maintenance manual instructions.
 3. Install heat exchangers level and plumb in accordance with manufacturer's written instructions.
 4. Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.

2.9 FLOW CONTROL AND STRAINER VALVES

- A. Furnish and install pressure-compensating flow control valves in a union (or flanges)/flow-control-device/ball-valve configuration. One piece configuration for valves 3" and smaller.
- B. Valves are to be installed where indicated on plans and in hydronic piping systems, serving hydronic coils, and hydronic radiation. Flow control valves will be installed in the return line.
- C. All valves shall have access capability to allow field-exchange of internal components without removing valve body from pipeline.
 - 1. All valves shall be permanently marked to show direction of flow, flow rate, and pressure range.
 - 2. All flow control valve cartridges shall be of stainless steel construction. Brass/Bronze cartridge construction shall **not** be acceptable.
- D. Furnish and install an in-line strainer for each flow control valve furnished that is 2" and smaller. Strainer to be in a union/strainer/ball valve configuration.
- E. Furnish and install as part of each flow control valve and strainer valve a Pete's plug ¼" MPT fitting to receive either a temperature or pressure probe. Fitting shall be solid brass.
 - 1. Chilled water flow control valve and strainer valves shall have extended Pete's plug ports to accommodate chilled water insulation.
- F. Flow control valve shall be Pro Hydronics, Autoflow FV Series, Griswold Controls, or approved equal.
- G. Strainer valves shall be Pro Hydronics, Autoflow SV Series, Griswold Controls, or approved equal.
- H. If any flow controls are found to be installed backwards when balancing is performed, entire autoflow valve shall be replaced by this contractor.
- I. Furnish and install manual calibrated balancing valves in a union (or flanges)/flow-control/ball valve configuration. Valves are to be installed where indicated on plans and details. All valves shall be permanently marked to show direction of flow, flow rate, and pressure range.
 - 1. Valve body shall be constructed out of cast iron and rated for 175 psig working pressure.
 - 2. Valve body shall include two pressure/temperature ports.
 - 3. Valve body shall include an optional drain valve port.
 - 4. Valve shall utilize a calibrated nameplate with a memory stop.
 - 5. Valve temperature range shall be from -4deg F to 250deg F.
 - 6. Chilled water balancing valves (and any valves with P/T ports on geothermal system in building) shall have extend P/T plug ports to accommodate chilled water insulation.
- J. Manual calibrated balancing valves shall be Bell & Gossett Circuit Setter model CB or equal.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Coordinate applications below with materials specified in this Section. Pipe sizes at which joining methods change are between NPS 2 and NPS 2-1/2 (DN 50 and DN 65). Adjust this change point to suit personal preference. Soldered joints for pipes larger than NPS 2 (DN 50) may not meet system pressures.
- B. Chilled Water and Hot Water Heat Piping Systems: Type L drawn-temper copper tubing with soldered joints.
- C. Chilled Water and Hot Water Heat Piping Systems: Schedule 40 steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints and fittings for 2-1/2 inch and larger.
- D. Chilled Water and Hot Water Heat Piping Systems: Schedule 40 steel pipe with mechanical couplings.
- E. Chilled Water and Hot Water Heat Piping Systems: Type L drawn-temper copper tubing with mechanical couplings.

- F. Chilled Water, Infloor Heat, and Ice Melt Piping Systems: Uponor SDR 9 PEX-A tubing with Uponor one-piece cold expansion F1960 fittings. Crimp ring fittings shall not be acceptable. Uponor fittings must be used with Uponor pipe and must meet all requirements to achieve full warranty coverage.

3.2 VALVE APPLICATIONS

- A. Unless otherwise indicated, use the following general-duty valve types for applications indicated:
 - 1. Shutoff Duty: Ball, and butterfly valves.
 - 2. Throttling Duty: Ball, and butterfly valves.
- B. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, and elsewhere as indicated.
- C. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.
- D. Install calibrated plug or automatic flow control valves on the outlet of each heating or cooling element and elsewhere as indicated to facilitate system balancing.
- E. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.
- F. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- G. Install safety relief valves on hot-water generators and elsewhere as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to floor. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.

3.3 METER AND GAGE INSTALLATION

- A. Calibrate and install meters, gages, and accessories according to manufacturer's written instructions for applications where used.
- B. Thermometer Installation
 - 1. Install thermometers and adjust vertical and tilted positions.
 - 2. Install in the following locations:
 - a. As shown on piping details of plans.
 - 3. Install remote-reading dial thermometers in control panels with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.
 - 4. Install thermometer wells in vertical position in piping tees where test thermometers are indicated.
 - a. Install with stem extending a minimum of 2 inches into fluid.
 - b. Fill wells with oil or graphite and secure caps.
- C. Pressure Gage Installation
 - 1. Install pressure gages in piping tees with pressure-gage valve located on pipe at most readable position.
 - 2. Install dry-type pressure gages in the following locations:
 - a. As shown on piping details of plans.
 - 3. Install liquid-filled-type pressure gages at suction and discharge of each pump.
- D. Install pressure-gage needle valve and snubber in piping to pressure gages.

3.4 HYDRONIC PIPING INSTALLATIONS

- A. Install piping according to Section 23 0510 "Basic Mechanical Materials and Methods."
- B. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- C. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

- D. Install piping at a uniform grade of 0.2 percent upward in direction of flow. Install condensate piping at a uniform grade of ¼ inch per foot downward in direction of flow.
- E. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
- F. Install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.
- G. Install unions in pipes 2-inch NPS (DN50) and smaller, adjacent to each valve, at final connections of each piece of equipment, and elsewhere as indicated. Unions are not required at flanged connections.
- H. Install flanges on valves, apparatus, and equipment having 2-1/2-inch NPS (DN65) and larger connections.
- I. Install flexible connectors at inlet and discharge connections to pumps (except in-line pumps) and other vibration-producing equipment.
- J. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger.
- K. Anchor piping for proper direction of expansion and contraction.
- L. Uponor PEX-a piping with F1960 expandable fittings shall be installed in accordance with Uponor's Hydronic Piping Design Assistance Manual to ensure a 25 year system warranty.
- M. Install in floor heat tubing as shown on plans and per manufacturer's requirements.

3.5 HANGERS AND SUPPORTS

- A. Piping support must account for expansion and contraction, vibration, and dead load of piping and its contents, and seismic bracing requirements.
- B. Hanger, support, and anchor devices shall comply with requirements below for maximum spacing of supports. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
 - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
 - 4. Spring hangers to support vertical runs.
 - 5. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
 - a. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - b. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
 - c. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - d. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - e. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
 - f. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
 - 6. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
 - a. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
 - b. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
 - c. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - d. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
 - e. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
 - f. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
 - 7. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

8. PEX-a Piping Hanger Spacing: Install hangers for PEX-a piping with the following maximum spacing:
 - a. 1 inch and below: Maximum span, 32 inches.
 - b. 1-1/2 inch and above: Maximum span, 48 inches.
9. PEX-a Piping Hanger Spacing with PEX-a Support Channel: Install hangers for PEX-a piping with horizontal support channel in accordance with local jurisdiction and manufacturer's recommendations, with the following maximum spacing:
 - a. Maximum span, 8 feet.
10. PEX-a Riser Supports: Install CTS riser clamps at the base of each floor and at the top of every other floor. Install mid-story guides between each floor.
11. Pipe Joint Connections: Install per manufacturer's recommendations. Use manufacturer-recommended cold-expansion tool for F1960 connections.

3.6 PIPE JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Basic HVAC Materials and Methods" for joint construction requirements for soldered and brazed joints in copper tubing; threaded, welded, and flanged joints in steel piping.
- B. Mechanical Joints: Assemble joints according to fitting manufacturer's written instructions.

3.7 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual (not automatic) full port ball valve operated air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting. Install ball isolation valves with chained caps.
 1. Existing Heating hydronic system being tied into (40% Propylene):
 - a. Prior to any proposed work, the plumbing/hydronics contractor shall provide a complete analysis of the existing hot water heating system to determine exact glycol and composition, etc. Submit analysis/recommendations to Sichmeller engineering & Owner. Owner to provide any recommended adjustments to existing.
 - b. The plumbing contractor shall be responsible for draining and storing the existing glycol solution.
 - c. The plumbing contractor shall be responsible for cleaning and flushing the new hot water heating system piping. The existing hot water heating system shall be drained as necessary for proposed tie ins and filled with new glycol solution, no cleaning and flushing on existing piping.
 - d. Upon completion of the proposed work & system flushing, the existing glycol solution shall be pumped back in along with the owner provided adjustments and proposed system solution.
 - e. After proposed work is complete, the plumbing/hydronics contractor is to provide a complete analysis of the hot water heating system to confirm proper glycol % and treatment. Submit analysis/recommendations to Sichmeller engineering & owner. If solution analysis indicates solution is not satisfactory, this contractor to make adjustments as recommended by glycol supplier & retest until analysis is satisfactory.
 2. Existing Chilled Water system being tied into (35% Ethylene):
 - a. Prior to any proposed work, the plumbing/hydronics contractor shall provide a complete analysis of the existing hot water heating system to determine exact glycol and composition, etc. Submit analysis/recommendations to Sichmeller engineering & Owner. Owner to provide any recommended adjustments to existing.

- b. The plumbing contractor shall be responsible for draining and storing the existing glycol solution.
 - c. The plumbing contractor shall be responsible for cleaning and flushing the new hot water heating system piping. The existing hot water heating system shall be drained as necessary for proposed tie ins and filled with new glycol solution, no cleaning and flushing on existing piping.
 - d. Upon completion of the proposed work & system flushing, the existing glycol solution shall be pumped back in along with the owner provided adjustments and proposed system solution.
 - e. After proposed work is complete, the plumbing/hydronics contractor is to provide a complete analysis of the hot water heating system to confirm proper glycol % and treatment. Submit analysis/recommendations to Sichmeller engineering & owner. If solution analysis indicates solution is not satisfactory, this contractor to make adjustments as recommended by glycol supplier & retest until analysis is satisfactory.
3. New & Existing Ice Melt heating system serving sidewalk and drive up (50% Propylene):
 - a. The plumbing contractor shall be responsible for cleaning and flushing the new hydronic system piping prior to pumping in new cooling solution/startup.
 - b. After proposed work is complete, the plumbing/hydronics contractor is to provide a complete analysis of the hydronic system to confirm proper glycol % and treatment. Submit analysis/recommendations to Sichmeller engineering & owner. If solution analysis indicates solution is not satisfactory, this contractor to make adjustments as recommended by glycol supplier & retest until analysis is satisfactory.
 4. Install automatic air vents in mechanical equipment rooms only at high points of system piping, at heat-transfer coils, and elsewhere as required for system air venting.

3.8 TERMINAL EQUIPMENT CONNECTIONS

- A. Size for supply and return piping connections shall be same as for equipment connections.
- B. Install control valves in accessible locations close to connected equipment.
- C. Install flow control valves and strainer valves as shown on piping details.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.
- B. Prepare hydronic piping and perform testing according to ASME B31.9. Prepare written report of testing.

3.10 ADJUSTING AND CLEANING

- A. Consult with and comply with boiler manufacturer's recommendations.
- B. After completing systems installation, including outlet fittings and devices, inspect finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.
- C. Flush hydronic piping systems with clean water. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.
- D. Preparation for testing: Prepare hydronic piping in accordance with ASME B 31.9.
- E. Testing: Test hydronic piping as specified in ASME B 31.9 "Building Services Piping."
- F. System Cleaning:
 1. Fill the entire system with clean, fresh water and properly vent. Repair piping leaks as early in this procedure as they are discovered. Inspect existing piping system and notify engineer immediately for any leaks requiring repairs. With valves positioned by bypass

the boiler and terminal equipment, start the pump to circulate water through the system. Check strainers at pumps and at terminal equipment (new and existing) frequently and clean as often as needed. If the water is extremely dirty or murky, flush continuously, using the system pump, until the water being flushed out of the pipe loop has become clear. To flush in this manner requires care to be certain that make-up water is being added fast enough to replace what is being flushed out. Accomplish this by opening the make-up water bypass valve around the automatic pressure reducer valve and adjust the manual valve so that the pump suction pressure gauge continues to indicate the same positive pressure that existed before the manual drain and make-up valves were opened. Continue for at least two hours. Once the water is clear and debris flushed out, stop the pump.

2. To complete the cleaning, fill the system with fresh water, adding a cleaning agent such as trisodium phosphate (TSP). Disconnect all power to the terminal units so that they will not operate while the system is being cleaned. Then circulate cleaning solution throughout the system, with boiler controls temporarily adjusted to raise the solution temperature to about 105 deg F to 110 deg F. Do not allow the temperature to rise above 110 deg F. Alternate operation of the primary and standby pumps and circulate the warm solution for several hours. Then turn off the boiler and pump, completely drain the system, and refill with fresh water. Repeat the cleaning process only if there is indication of foreign matter still in the system or if a test of the water indicated that it is slightly acid.
 3. Water should be slightly alkaline, with a pH no higher than 8.0 and no lower than 7.0.
 4. Add propylene glycol to heating hydronic piping system to provide a total of 40% by volume.
 5. Add ethylene glycol to chilled water hydronic piping system to provide a total of 35% by volume.
 6. Add propylene glycol to Ice Melt heating hydronic piping system to provide a total of 50% by volume.
- G. Install laminated engraved placard near boilers, chiller pumps, and Ice Melt Heat Exchangers with 1" engraved letters indicating glycol type & concentration.
- H. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.
- I. Chemical Treatment: Provide a water analysis prepared by chemical treatment supplier to determine type and level of chemicals required to prevent scale and corrosion. Perform treatment after completing system testing and retest as necessary. If solution analysis is not satisfactory, make adjustments as recommended by glycol supplier and retest as necessary until analysis is satisfactory.

3.11 COMMISSIONING

- A. Fill system and perform initial chemical treatment.
- B. Check expansion tanks to determine that they are not air bound and that system is completely full of water.
- C. Perform these adjustments before operating the system:
 1. Open valves to fully open position. Close coil bypass valves.
 2. Check pump for proper direction of rotation.
 3. Set automatic fill valves for required system pressure.
 4. Check air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
 5. Set temperature controls so all coils are calling for full flow.
 6. Check operation of automatic bypass valves.

7. Check and set operating temperatures of boilers, chillers, and cooling towers to design requirements.
8. Lubricate motors and bearings.

3.12 MISCELLANEOUS CONNECTIONS

- A. Make all hydronic connections. This includes boiler connections, connections of heating coils to equipment supplied and/or mounted under HVAC Section. This includes piping, valves, strainers, air vents, thermometers, immersion bulbs, flow switches, drains, unions, etc.
- B. Install all control valves supplied by Automatic Temperature Control Contractor.

3.13 AUTOMATIC TEMPERATURE CONTROL

- A. Install the automatic temperature control dampers, air flow monitoring devices, openings for air flow switches, alarms and control devices as provided by the Automatic Temperature Control Contractor. These dampers and devices shall be installed under the direct supervision of the Section 23 0900, CONTROLS & CONTROL SEQUENCES Temperature Control Contractor and in strict accordance with the manufacturer's recommendations.

END OF SECTION 23 2113

**SECTION 232123
HVAC HYDRONIC PUMPS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The Work covered in this section of the Specifications is intended to include the furnishing of all equipment, materials and labor reasonably incidental to the complete operating installation of the base mounted end-suction ground loop pumps and pertaining equipment as indicated on the drawing.
- B. This Section includes the following:
 - 1. In-Line Circulator Pumps for Infloor Heating and Ice Melt
 - 2. Vertical In-Line Pumps Rated for VFD Application

1.3 PERFORMANCE REQUIREMENTS

- A. Pump Pressure Ratings: At least equal to system's maximum operating pressure at point where installed, but not less than specified.

1.4 SUBMITTALS

- A. Shop Drawings: Shop drawings as specified in Section 230500 shall include the following:
 - 1. In-Line Circulator Pumps for Infloor heat and ice melt.
- B. Product Data: Include certified performance curves and rated capacities; furnished specialties; final impeller dimensions; and accessories for each pump indicated. Indicate pump's operating point on curves.
- C. Shop Drawings: Shop drawings as specified in Section 230500 shall include the following:
 - 1. Power, signal, and control wiring diagrams differentiating between manufacturer-installed wiring and field-installed wiring.
- D. Show pump layout and connections. Include Setting Drawings with templates for installing foundation and anchor bolts and other anchorages.
- E. Operation and maintenance data including startup instructions.

1.5 QUALITY ASSURANCE

- A. UL Compliance: Fabricate and label pumps to comply with UL 778, "Motor-Operated Water Pumps," for construction requirements.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Single-Source Responsibility: Obtain each category of pumps from one source and by a single manufacturer.
- D. Provider shall be responsible for providing certified factory authorized equipment start-up and, when noted, an in the field certified training session. New pump start-up shall be for the purpose of determining pump alignment, lubrication, voltage, and amperage readings. All proper electrical connections, pump's balance, discharge and suction gauge readings, and adjustment of head, if required. A copy of the start-up report shall be made and sent to both the contractor and to the Engineer.

PART 2 - PRODUCTS

2.1 IN LINE CIRCULATOR PUMPS

- A. The contractor shall furnish and install inline pumps as illustrated on the plans and in accordance with the following specifications:
 - 1. The pumps shall be of the horizontal, permanently lubricated type or wet rotor type, specifically designed and guaranteed for quiet operation.
 - 2. The pumps shall have a steel shaft supported by permanently lubricated, sealed precision ball bearings. The pumps are to be equipped with a water-tight seal to prevent leakage. Mechanical seal faces to be carbon on silicon carbide. The motor shall be non-overloading at any point on the pump performance curve.

3. The motor shall be of the drip-proof, sealed precision ball-bearing, quiet-operating construction. The EC motor shall be equipped with the capability of accepting a 0-10VDC input or equivalent communication from the TC for control by the BAS.
4. Pumps to be suitable for minimum 225°F (107°C) operating temperature at 150 psig (10 bar)

2.2 VERTICAL IN-LINE PUMPS RATED FOR VFD APPLICATIONS

- A. Furnish and install circulating pumps rated for VFD application where shown on the Drawings. Type, size, and performance shall be as tabulated in the schedule and on the drawings.
- B. MANUFACTURERS
 1. The specifying engineer reserves the right to specify a primary supplier / lead spec manufacturer on all supplied schedule and specification documents. These primary suppliers have led their respective industry in research and development and their products have had proven track records in the field. These primary suppliers, in the opinion of this engineering firm, produce a superior product to the alternately listed manufacturers. The contractor may choose to supply equivalent equipment as manufactured by the alternately specified manufacturer. This alternately specified equipment shall be supplied on a deduct alternate basis and based on the approval of the supplied alternate manufacturer's submittals. The use of a primary supplier and deduct alternates protects the specifying engineer's design concept, but allows for a check-and-balance system to protect the post-commissioning owner.
 2. Contractor shall furnish new close-coupled vertical inline pump for hydronic systems as indicated on the drawings. Pumps shall be manufacturer specified under base bid. Equivalent units as manufactured by other manufacturers may be submitted as deduct alternates. Pumps shall meet types, sizes, capacities, and characteristics as scheduled on the Equipment Schedule drawings. Pump substitutions shall be provided with connection sizes equal to those scheduled. Pump connections shall not be downsized. Pump substitutions shall not be provided at efficiencies less than those scheduled.
 3. Or engineer prior approved equal.
- C. COMPONENTS
 1. The pumps shall be close-coupled, inline for vertical or horizontal installation, in cast iron stainless steel fitted construction specifically designed for quiet operation. Suitable standard operations at 225°F and 175 PSIG working pressure (or optional operations at up to 250°F and 250 PSIG working pressures). Working pressures shall not be de-rated at temperatures up to 250°F. The pump internals shall be capable of being serviced without disturbing piping connections.
 2. As an option an EPR/Carbon/Tungsten/Carbide/SS seal (250°F maximum operating temperature), FKM/Carbon/Ceramic/SS seal, or EPR-Silicon Carbide/Silicon Carbide/SS seal may be used in lieu of the standard Buna/Carbon/Ceramic/SS seal (225° F maximum operating temperature).
 3. The pumps shall have a solid alloy steel shaft that is integral to the motor. A non-ferrous shaft sleeve shall be employed to completely cover the wetted area under the seal.
 4. The motor bearings shall support the shaft via heavy-duty grease lubricated ball bearings.
 5. Pump shall be equipped with an internally flushed mechanical seal assembly installed in an enlarged tapered seal chamber. Seal assembly shall have a stainless steel housing, Buna bellows and seat gasket, stainless steel spring, and be of a carbon ceramic design with the carbon face rotating against a stationary ceramic face. (As an option, a stuffing box designed may be used in lieu of the traditional internally flushed mechanical seal design. Pump shall be flushed single seal, flushed double seal, or packing gland type seal arrangements.)
 6. Pump shaft shall connect to a stainless steel impeller. Impeller shall be hydraulically and dynamically balanced to Hydraulic Institute Standards ANSI/HI 9.6.4.5-2000. The allowable residual imbalance conforms to ANSI grade 6.3, keyed to the shaft and secured by a stainless steel locking capscrew or nut.
 7. Pump should be designed to allow for true back pull-out access to the pump's working components for ease of maintenance.

8. Pump volute shall be of a Class 30 cast iron design for heating systems rated for 175 PSIG with integral cast iron flanges drilled for 125# ANSI companion flanges (Optional 250 and 300 PSIG working pressures are available and are 250# flange drilled). Volute shall include gauge ports at nozzles, and vent and drain ports. The volute shall be designed with a base ring matching an ANSI 125# flange that can be used for pump support.
 9. Motors shall meet scheduled horsepower, speed, voltage, and enclosure design. Motors shall have heavy-duty grease lubricated ball bearings to offset the additional bearing loads associated with the closed-coupled pump design. Motors shall be non-overloading at any point on the pump curve and shall meet NEMA specifications.
 10. Pumps shall conform to ANSI/HI 9.6.3.1 standard for Preferred Operating Region (POR) unless otherwise approved by the engineer.
 11. Pump shall be of a maintainable design and for ease of maintenance should use machine fit parts and not press fit components.
 12. Pump manufacturer shall be ISO-9001 certified.
 13. Each pump shall be factory tested and name-plated before shipment.
 14. As an option, the pump may include internal stainless steel casing wear rings.
 15. Where noted on schedule pumping equipment may require one or all of the following optional tests: Certified Lab tests (unwitnessed), Hydraulic Institute Level B tests, or Witnessed Tests.
 16. Pumps shall include NEMA premium efficiency motors rated for VFD application and shall be provided with shaft grounding kits.
- D. Provide accessories as scheduled on the plans.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, equipment foundations, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting performance of the pumps.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
- C. Examine supporting structure for suitable conditions where pumps are to be installed.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

- A. Install pumps according to manufacturer's written installation and alignment instructions.
- B. Install pumps to provide access for periodic maintenance, including removing motors, impellers, couplings, and accessories.
- C. Support pumps and piping separately so piping is not supported by pumps.
- D. Set base mounted pumps on concrete foundation. Provide & install inertia bases where shown on plans. Disconnect coupling halves before setting. Do not reconnect couplings until alignment operations have been completed.
 1. Support pump base plate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of $\frac{3}{4}$ to 1-1/2 inches between pump base and foundation for grouting.
 2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

3.3 ALIGNMENT

- A. Align pump and motor shafts and piping connections after setting them on foundations, after grout has been set and foundation bolts have been tightened, and after piping connections have been made.
- B. Comply with pump and coupling manufacturer's written instructions.
- C. Adjust alignment of pump and motor shafts for angular and parallel alignment by 1 of 2 methods specified in the H.I.'s Standards for Centrifugal, Rotary & Reciprocating pumps, "Instructions for Installation, Operation, and Maintenance."
- D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Fill base plate completely with nonshrink, nonmetallic grout, with metal blocks and shims or wedges in place. After grout has cured, fully tighten foundation bolts.
- E. Alignment Tolerances: According to manufacturer's recommendations.

3.4 CONNECTIONS

- A. Install shutoff valve and strainer on pump suction and check valve and shutoff valve on pump discharge, except where other arrangement is indicated.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect piping to pumps. Install valves that are the same size as piping connected to pumps.
- D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- E. Retain paragraph above or first three paragraphs below if specialty valves are required for vertical in-line pumps.
- F. Install suction diffuser and shutoff valve on suction side of pumps.
- G. Install manual balancing valve on discharge side of pumps where indicated.
- H. Install non-slam check valve on discharge side of pumps where indicated.
- I. Install flexible connectors on suction and discharge sides of base-mounted pumps and where indicated. Install between pump casing and valves, except where other arrangement is indicated.
- J. Install thermometers where indicated.
- K. Install pressure gages on pump suction diffuser, pump suction, and pump discharge per details on plans. Install at integral pressure-gage tapings where provided.
- L. Install temperature and pressure gage connector plugs in suction and discharge piping around each pump.
- M. Install electrical connections for power, controls, and devices. Electrical power and control wiring and connections are specified in Division 26 Sections.

3.5 FIELD QUALITY CONTROL

- A. Check suction piping connections for tightness to avoid drawing air into pumps.
- B. Clean strainers.
- C. Set pump controls.

3.6 AUTOMATIC TEMPERATURE CONTROL

- A. Install the automatic temperature control dampers, air flow monitoring devices, openings for air flow switches, alarms and control devices as provided by the Automatic Temperature Control Contractor. These dampers and devices shall be installed under the direct supervision of the Section 23 0900, CONTROLS & CONTROL SEQUENCES Temperature Control Contractor and in strict accordance with the manufacturer's recommendations.

END OF SECTION 232123

**SECTION 23 7000
VENTILATION AND AIR CONDITIONING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The work in this section of the specification and the accompanying drawings consists of performing all labor and furnishing of all material and equipment necessary to install air handling systems as indicated on drawings and specified herein, including minor items obviously necessary for complete and operating systems.
- B. Also included is the work involved to remove existing associated equipment, remodeling of existing systems, including connections between new and existing systems.

1.3 SUBMITTALS

- A. Shop Drawings: Shop drawings as specified in Section 23 0500 shall include the following:
 - 1. Paintgrip duct where exposed, EZ Flange with Barrel Clamp on Exposed Spiral
 - 2. Double Wall Water Heater Venting Materials.
 - 3. Shutoff VAV/Reheat Terminals
 - 4. Fan Coil with DX Cooling Coils
 - 5. Packaged Rooftop Unit with Modulating DX Cooling and Modulating Hot Gas Reheat
 - 6. Air Cooled Condensing Units
 - 7. Duct Mounted Hot Water Heating Coils
 - 8. Shutoff VAV Air Terminals
 - 9. Power Roof Ventilators
 - 10. Ceiling Exhaust Fans
 - 11. Intake Hoods
 - 12. Fire/Smoke Dampers
 - 13. Registers, Grilles, Diffusers
 - 14. Motorized Control Dampers
 - 15. Filter List & Filters – At the end of the project the HVAC contractor to provide an additional set of disposable filters.
 - 16. Spare Parts

PART 2 - PRODUCTS

2.1 INTERNAL DUCT INSULATION

- A. See HVAC Systems Insulation.
- B. All internal duct insulation shall be 1/2" as specified duct liner with black fire resistant skin surface. Liner shall have an overall density of 2.0 lbs./cu. ft. Installation shall meet NFPA 90A and 90B fire resistant requirements.
- C. Apply the insulation in fabricated pieces sized to the interior duct surfaces with the black coated or denser surface exposed to the air stream. Insulation shall be firmly held in place with B.F. 85-10 or 85-60, C.M.C. 17-477, 1-C 225 fire resistant adhesive covering no less than 100% of the duct surface. Further secure insulation on the top and sides of horizontal ducts and all sides of vertical ducts with Omark or KSM capacitor discharge studs and caps on 15" centers. Secure transverse edges with capacitor discharge studs and caps on 6" centers.
- D. Duct sizes indicated on the drawings are the internal dimensions. Where insulation is applied to the inside of ducts, the metal size of the duct shall be increased to result in internal dimensions equal to that shown on the drawings.

2.2 SHEET METAL WORK – LOW & MEDIUM PRESSURE SYSTEMS

- A. See plans and insulation specifications for exposed ducts to be paint grip.
- B. Unless otherwise specified, construct ducts from galvanized iron fabricated and erected in a workmanlike manner. Fabricate plenums and special fittings, as shown on the Drawings, or as required. Access doors to plenums shall be double wall construction with heavy hardware. All ductwork shall be of the gauges hereinafter specified and constructed to the best grade Inland, U.S. Steel, United Sheet Metal or equal brands, heavily galvanized.
- C. Metal gauges for low and medium pressure duct systems shall be of metal gauges and reinforcing as recommended by SMACNA or as follows:

Max. Dimension of Rect.

Ducts or Dia. of Round <u>Low Pressure Ducts</u>	Galvanized Sheet <u>Steel Gauge Number</u>
Up thru 12"	26
Over 12" thru 30"	24
Over 30" thru 54"	22
Over 54" thru 84"	20
Over 84"	18

Maximum Dimension of

Rectangular Ducts or Diameter of Round <u>Medium Pressure Ducts</u>	Galvanized Sheet <u>Steel Gauge Number</u>
Up thru 18"	24
Over 19" thru 48"	22
Over 49" thru 72"	20
Over 73" thru 96"	18

- D. Ductwork shall be constructed, braced, reinforced and sealed as recommended by ASHRAE and SMACNA. Low pressure ductwork shall be suitable for pressures up to 2 inch w.g. Medium pressure ductwork shall be suitable for pressures up to 3 inch w.g. All ductwork 18 inches and greater in width shall be cross-broken. See SMACNA requirements for proper sealing of ductwork. All supply air ductwork between VAV air handling units and VAV terminals shall be medium pressure construction.
- E. Low pressure ductwork with the longest side 36" wide and over, or medium pressure ductwork shall be constructed using Ductmate 35/25 or equal slide on systems, per Ductmate Industries Installation Procedures and Duct Construction Standards, latest edition. The non-proprietary SMACNA T-22 Flanged Connection may be used as defined on Page 1-25 and 1-37, of the 1985 SMACNA Manual, First Edition. Ductmate 35/25 may be used for transverse joint construction, 35" wide and smaller. Ductmate 440 Butyl Gasket, or equal, shall be used between all rectangular transverse flanged duct connections, Ductmate's 440 Butyl Gasket, shall be used with the Ductmate Systems. For rectangular ductwork located outdoors, exposed to weather, construct ductwork per, 'Transverse Joints Rectangular' with using a continuous metal cleat on top joints of ducts for added weather protection. Slide on systems shall be Ductmate, Ward Industries, Inc., or equal.
- F. No obstruction shall be permitted in the ductwork to retard the flow of air. If it is necessary to run a pipe or conduit through a duct, the duct size shall be increased to compensate for the obstruction.
- G. Where space permits, duct turns shall be constructed with an inside radius equal to or greater than the duct width or duct turn vanes may be used. Where space does not permit duct turns as described above, duct turn vanes shall be used.
- H. Where interior duct insulation is required, increase the duct size to maintain the free area shown on the Drawings.

- I. Provide exterior insulated drip pans, 3 inches deep, under or adjacent to all roof and wall openings including but not limited to under all intake or relief hoods and louvers. Drip pans to be soldered watertight.
- J. Power operated dampers not furnished as a component of the ventilating machines will be furnished under the Temperature Control Specifications. They shall be installed in the ductwork under this specification. Caulk around all sides of high efficiency damper frames.
- K. Flexible connections shall be installed between suction and discharge openings in fan units and the ducts with which they are connected as shown on the Drawings, to prevent transmission of vibration noises. Material shall be watertight and fire retardant canvas weighing not less than 20 ounces per square yard, or shall be glass fabric on high temperature systems where fire hazard exists. Both materials shall be approved by Underwriter's Laboratories. The flexible material shall be furnished with all necessary angles, bolts, clips or other fasteners.
- L. Furnish and install access panels in the ductwork adjacent to all motorized dampers, fire dampers, louvers, reheat coils, and equipment which may require servicing or cleaning. Panels shall be tight fitting and shall be located so as to make them easily accessible. All panels installed in insulated ductwork shall be double wall, insulated type. Panels shall be Ruskin, Air Balance, Ventlok, ADCO, or equal.
- M. Dynamic rated fire dampers shall have an 18 inch square access panel or an 18 inch long removable duct section shall be installed adjacent to dynamic rated fire dampers in addition to a smaller inspection access panel. The removable section shall be assembled using Ductmate or equal duct joints. The joint at the damper shall be assembled with plastic fastener clips. Ductwork 24 inches and wider shall have an 18 inch by 18 inch access door in lieu of removable section.
- N. Ductwork installed above UL fire rated ceiling assemblies shall be installed in strict accordance with the provisions required by the UL Design Number designated in the Underwriters Laboratories Fire Resistance Directory.
- O. All ductwork visible through the face of a register or grille shall be painted with a flat black paint.
- P. All rigid and flexible ductwork materials installed shall have composite fire and smoke hazard ratings as tested by procedures ASTM 84, NFPA 255 and UL 723 not to exceed 25 Flame Spread and 50 Smoke Developed.
- Q. Concealed low pressure round ductwork may be rigid spiral ductwork or snaplock type with adjustable elbows.
- R. All exposed round ductwork and round ductwork to the inlet of VAV terminals shall be United, Semco, Norlock, Foremost or equal, rigid spiral duct and fittings.
- S. All exposed ductwork to be PAINTGRIP and shall be United, Semco, Norlock, Foremost or equal, rigid spiral duct and fittings. Refer to architectural reflected ceiling plans.
- T. Round ductwork shall be supported at 6 feet o.c. where building framing does not provide such support. Support shall be minimum 3/4 inch metal strap suspended from the roof or framing. Flexible duct shall not exceed 8 feet in length or pass through walls. Flexible round ductwork may only be used for final connections to supply registers and diffusers and shall not be used on return or exhaust ductwork.

2.3 DUCT HANGERS AND SUPPORTS

- A. Securely attach all ductwork to the building construction in a manner to be free of vibration and swaying under all conditions of operation. Hanger attachments shall be appropriate for the building structure and shall be subject to the A/E's approval. Hang ducts from beams and joist whenever possible.
- B. Ducts shall be substantially supported with hangers located according to SMACNA standards.

2.4 DUCT INSTALLATION

- A. Duct sizes shown on the drawings are nominal inside dimensions. Where internal insulation is provided, duct sizes must be increased appropriately to maintain indicated inside dimensions.
- B. All ductwork will be run substantially as shown on the plans with bends and curves. Changes in size or cross section shall be made with long tapers. The A/E reserves the right to slightly change the run of certain ducts without extra cost to the Owner, if necessary to avoid unforeseen structural or other interferences.
- C. Where ducts run through bar joists or other ceiling spaces and structural, mechanical, or electrical interference is encountered, maintain same cross sectional area as indicated on plans with a maximum of 4-1/2 to 1 aspect ratio.
- D. All openings in duct for grilles, registers, etc. shall be capped dust-tight with G.I. Metal caps during the construction period.
- E. Round branch duct connections to rectangular mains shall be made with round manual balancing dampers meeting the following specifications: Dampers shall consist of a 20 ga. Galvanized steel; 3/8" square plated steel axles turning in acetal bearings. Damper shall include optional 1-1/2" standoff bracket (with extended pin) to accommodate for the thickness of external duct insulation. Dampers have quadrant operator and shall be suitable for pressures to 1.0" w.g., velocities to 2000 f.p.m. and temperatures to 180 degrees F. Testing and ratings to be in accordance with AMCA Standard 500. Basis of design is Greenheck model MBDR-50.
- F. Exhaust/relief air, and air intake ducts shall be equipped with 3" deep watertight pans to collect moisture and condensate. Seal all joints with sealant.
- G. All changes in direction shall be made with curved elbows having a centerline radius equal to 1-1/2 times the duct width. Where space conditions prevent the use of curved elbows and/or where square turns are indicated, provide square turn elbows with turning vanes. Vanes may be either commercial type ductturns or equal, or shop fabricated to conform to SMACNA standards. Vanes shall be double thickness type pre-assembled on runners before installing in each elbow. Brace adequately and avoid rough edges to prevent objectionable noise.

2.5 ACCESS PANELS

- A. Provide access panels to permit inspection and maintenance of all hot water coils, motorized volume dampers, smoke dampers, control equipment, and other equipment requiring maintenance. Panels shall be located in position dictated by the equipment such that maintenance may be performed. Panels shall not be located in top side of ducts.
- B. Panels shall be attached to duct with zinc plated cam latches. 18" x 18" and smaller panels shall have a minimum of two (2) latches. Larger panels shall have a minimum of four (4) latches. Panel shall set in rigid frame with sponge rubber gasketing to prevent air leakage. Where ductwork is insulated, panels shall be of double wall construction with 1" rigid insulation fill.
- C. Where duct size permits, access panels shall be a minimum 18" x 16" or 2" smaller than duct size, whichever is smaller.

2.6 CURBS AND FLASHING

- A. Curb for roof mounted equipment shall be provided by this contractor, unless otherwise specified and scheduled. This contractor shall also provide counterflashing. The counterflashing shall be galvanized sheet metal, and all joints shall be soldered watertight.
- B. Curb on all roof-mounted equipment shall be fully insulated.
- C. Curbs on equipment with fresh air intake shall be minimum 18" high.
- D. Flashing will be provided under the General Contract.
- E. Roofing work to be by the roofing contractor.

- F. Coordinate the roof slope with construction manager prior to submitting shop drawings.

2.7 DOUBLE WALL WATER HEATER VENTING SYSTEM

- A. Furnish & install Selkirk Inc. Model UT Double Wall pressure rated venting system 304 stainless steel inner, 430 stainless outer, manufacturer required supports, & rain cap.
- B. Connect breeching to water heater outlet, full size of outlet. The water heater shall operate under positive (Category III) or negative (Category II) stack pressure.
- C. Provide with 1" ceramic insulation.

2.8 SHUTOFF VAV/REHEAT TERMINALS

A. GENERAL

1. Furnish and install single duct, variable volume air distribution assemblies with hydronic reheat of the type, size, and performance shall be as tabulated in the schedule and on the drawings.
2. The assemblies shall be pressure independent and shall reset to any air flow between zero and the maximum cataloged air volume. At an inlet velocity of 2,000 fpm, the differential static pressure for any unit with attenuator section, sizes 4 through 16, shall not exceed 0.11" w.g.
3. Sound ratings of air distribution assemblies, shall not exceed 25 NC.
4. Performance shall be ARI Certified.
5. The air flow sensor shall be of a cross configuration located at the inlet of the assembly. The sensor shall have twelve total pressure sensing ports and a center averaging chamber designed to accurately average the flow across the inlet of the assembly. Sensor shall provide accuracy within 5% with a 90° sheet metal elbow directly at the inlet of the assembly. The air flow sensor shall amplify the sensed air flow signal.
6. The assembly casing shall be constructed of 22 gauge zinc coated steel, internally lined with 1/2 inch thick, dual density fiberglass insulation which complies with UL-181 and NFPA-90A. Any cut edges of fiberglass exposed to the airstream shall be coated with NFPA-90A approved sealant.
7. The primary air valve damper shall be heavy gauge metal, with peripheral gasket, pivoted in self-lubricating bearings. In the full closed position, air leakage past the closed damper shall not exceed 2% of the nominal catalog rating at 3" inlet static pressure, as rated by ARI Standard 880.

B. CONTROLS

1. The terminal unit controller shall be a dedicated, microprocessor-based, pressure independent VAV controller complete with electronic flow transducer. The controller shall be capable of stand-alone operation and have the ability to network with a building automation system, personal computer or portable operator interface device.
2. The electric actuator shall be 24 VAC bi-directional, direct coupled to the damper shaft. The actuator must be capable of operating in the stalled position without overheating or mechanical damage.
3. The terminal unit manufacturer shall provide a flow cross or two (2) pipe sensor suitable for interfacing with a differential pressure sensor.
4. The temperature control contractor shall furnish the terminal equipment controller, flow transducer, and electric actuator for installation on each terminal unit by the terminal unit manufacturer. The cost of factory mounting, wiring, enclosure to meet local code and any factory testing and programming of the terminal equipment controller shall be included by the terminal manufacturer.
5. All components shall be calibrated and pretested to ensure a fully functional unit.
6. The zone sensor shall be furnished by the Temperature Control Contractor and shall include temperature setpoint adjustment and access for connection of a hand-held operator terminal or portable computer.
7. The DDC control package shall be calibrated and factory set for the maximum and minimum flow rates as scheduled on the drawings.

8. The air terminal unit shall be designed, installed and field adjusted, if necessary, to maintain controlled pressure independent air flow.
9. All control components shall be mounted inside a protective metal enclosure.

C. WATER REHEAT COILS

1. Provide factory mounted hot water reheat coils as scheduled.
2. The coils shall be aluminum plate fin with copper tubes and sweat connections. Coil connections can be right hand or left hand and shall be coordinated with heating contractor. Control valves, automatic air vents and drain vents, shall be supplied and field installed by others.

- D. Provide and install options and accessories as noted on plans.

2.9 FAN COIL WITH DX COOLING

A. GENERAL

1. Provide fan coil with DX cooling coil as shown and scheduled on the construction drawings. Basis of design is the Daikin DVMT vertical fan coil.

B. CONSTRUCTION

1. All unit chassis shall be fabricated of heavy gauge galvanized steel panels able to meet 125 hour salt spray test per ASTM B-117. All exterior panels shall be insulated with 1/2" thick insulation with a maximum k value of .24 (BTU • in) / (hr • ft² • °F) and carry a 25/50 rating for flame spread/smoke developed per ASTM E-84, UL 723 and NFPA 90A.
2. The front panel shall include quarter turn quick open fasteners to allow for easy removal and access for service.
3. All exposed units shall have exterior panels fabricated of not less than 18 gauge galvanized steel. The front panel shall be attached with quarter turn quick open fasteners to allow for easy removal and access for service.

C. FAN ASSEMBLY

1. Motors shall be high efficiency, Electronically Commutated (EC) Motor capable of variable speed operation. Motor shall be capable of accepting a 2-10 VDC output from BAS. Single speed motors are not acceptable.
2. The fan assembly shall be removed and serviced through the front and safety panels.

D. COILS

1. All cooling coils shall optimize rows and fins per inch to meet the specified capacity. Coils shall have seamless copper tubes and shall be mechanically expanded to provide an efficient, permanent bond between the tube and fin. Fins shall have high efficiency aluminum surface optimized for heat transfer, air pressure drop and carryover.
2. All coils shall be hydrostatically tested at 450 PSIG air pressure under water, and rated for a maximum 300 PSIG working pressure at 200°F.

E. DRAIN PANS

1. Primary condensate drain pans shall extend under the entire coil section, and have an Antimicrobial Performance Rating of 0, no observed growth, per ASTM G-21. Drain pans shall be of one piece construction and be positively sloped for condensate removal. A P-Trap shall be furnished, factory piped to the condensate drain riser. The P-Trap shall be easily removed and serviced through the front panel.

F. FILTERS

1. All units shall be furnished with a minimum 1" nominal glass fiber 30% efficient MERV 8 throwaway filter. Filters shall be tight fitting to prevent air bypass. Filters shall be easily removable from the return air plenum, without the need for tools.

G. ELECTRICAL

1. Units shall be furnished with single point power connection. Provide an electrical junction box with terminal strip for motor and other electrical terminations. The factory mounted terminal wiring strip consists of a multiple position screw terminal block to facilitate wiring terminations for the electric control valves and thermostats.

2.10 AIR COOLED CONDENSING UNIT (CU-X)

- A. Furnish & install where indicated and as scheduled on the plans, a complete factory assembled, high efficiency outdoor air-cooled condensing units. The units shall be precharged with sufficient refrigerant for operation with evaporator coil and refrigerant tubing and be equipped with refrigerant line fittings which permit soldered or flare connections. Unit shall include brass service valves with fitting and gauge ports located on the exterior of the cabinet.
- B. Refrigeration line sets & insulation to be UV resistant (exterior).
 - 1. See plans for proposed refrigerant lineset routing.
- C. Provide & install accessories as scheduled on the plans.

2.11 PACKAGED ROOFTOP UNIT WITH MODULATING DX COOLING AND MODULATING HOT GAS REHEAT

- A. General Description
 - 1. This section includes the design, controls and installation requirements for packaged rooftop units / outdoor air handling units.
- B. Quality Assurance
 - 1. Packaged air-cooled condenser units shall be certified in accordance with ANSI/AHRI Standard 340/360 performance rating of commercial and industrial unitary air-conditioning and heat pump equipment.
 - 2. Unit shall be certified in accordance with UL Standard 1995/CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.
 - 3. Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.
 - 4. Unit shall be certified in accordance with ANSI Z21.47b/CSA 2.3b and ANSI Z83.8/CSA 2.6, Safety Standard Gas-Fired Furnaces.
 - 5. Unit Energy Efficiency Ratio (EER) shall be equal to or greater that prescribed by ASHRAE 90.1, Energy Efficient Design of New Buildings except Low-Rise Residential Buildings.
 - 6. Unit shall be safety certified by ETL and ETL US listed. Unit nameplate shall include the ETL/ETL Canada label.
- C. Submittals
 - 1. Product Data: Literature shall be provided that indicates dimensions, operating and shipping weights, capacities, ratings, fan performance, filter information, factory supplied accessories, electrical characteristics and connection requirements. Installation, Operation, and Maintenance manual with startup requirements shall be provided.
 - 2. Shop Drawings: Unit drawings shall be provided that indicate assembly, unit dimensions, construction details, clearances and connection details. Computer generated fan curves for each fan shall be submitted with specific design operation point noted. Wiring diagram shall be provided with details for both power and control systems and differentiate between factory installed and field installed wiring.
- D. Delivery, Storage, and Handling
 - 1. Unit shall be shipped with doors screwed shut and outside air hood closed to prevent damage during transport and thereafter while in storage awaiting installation.
 - 2. Follow Installation, Operation, and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location.
 - 3. Unit shall be stored in a clean, dry place protected from construction traffic in accordance with the Installation, Operation, and Maintenance manual.
- E. Warranty
 - 1. Manufacturer shall provide a limited "parts only" warranty for a period of 12 months from the date of equipment startup or 18 months from the date of original equipment shipment from the factory, whichever is less. Warranty shall cover material and workmanship that prove defective, within the specified warranty period, provided manufacturer's written

instructions for Installation, Operation, and maintenance have been followed. Warranty excludes parts associated with routine maintenance, such as belts and filters.

F. Manufacturer

1. Products shall be provided by the following manufacturers:
 - a. AAON
 - b. Substitute equipment may be considered for approval that includes at a minimum:
 - 1) R-454b refrigerant
 - 2) Variable capacity compressor with 10-100% capacity control
 - 3) Direct drive supply fans
 - 4) Double wall cabinet construction
 - 5) Insulation with a minimum R-value of 13
 - 6) Stainless steel drain pans

G. Rooftop Units

1. General Description
 - a. Packaged rooftop unit shall include compressors, evaporator coils, filters, supply fans, dampers, air-cooled condenser coils, condenser fans, reheat coil, gas heaters, exhaust fans, and unit controls.
 - b. Unit shall be factory assembled and tested including leak testing of the DX coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the service compartment's literature pocket.
 - c. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
 - d. Unit components shall be labeled, including refrigeration system components, and electrical and controls components.
 - e. Estimated sound power levels (dB) shall be shown on the unit ratings sheet.
 - f. Installation, Operation, and Maintenance manual shall be supplied within the unit.
 - g. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.
 - h. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.
2. Construction
 - a. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.
 - b. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F.
 - c. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, reduces heat transfer through the panel, and prevents exterior condensation on the panel.
 - d. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.
 - e. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.

- f. Access to filters, dampers, cooling coils, reheat coil, heaters, compressors, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.
 - g. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
 - h. Units with cooling coils shall include double sloped 304 stainless steel drain pans.
 - i. Unit shall be provided with base discharge and return air openings. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch in height around the opening.
 - j. Unit shall include lifting lugs on the top of the unit.
3. Electrical
- a. Unit shall be provided with factory installed and factory wired circuit breaker.
 - b. Unit shall be provided with a factory installed and factory wired 115V, 12 amp GFI outlet disconnect switch in the unit control panel.
 - c. Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.
4. Supply Fans
- a. Unit shall include direct drive, unhooded, backward curved, plenum supply fans.
 - b. Blowers and motors shall be dynamically balance and mounted on rubber isolators.
 - c. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.
 - d. Variable frequency drives shall be factory wired and mounted in the unit. Fan motors shall be premium efficiency.
5. Cooling Coils
- a. Evaporator Coils
 - 1) Coils shall be designed for use with R-454B refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.
 - 2) Coils shall have interlaced circuitry and shall be 6 row high capacity.
 - 3) Coils shall be hydrogen or helium leak tested.
 - 4) Coils shall be furnished with factory installed expansion valves.
6. Refrigeration System
- a. Unit shall be factory charged with R-454b refrigerant.
 - b. Compressors shall be scroll type with thermal overload protection and carry a 5 year non-prorated warranty, from the date of original equipment shipment from the factory.
 - c. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam injected panels to prevent the transmission of noise outside the cabinet.
 - d. Compressors shall be isolated from the base pan with the compressor manufacturer's recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.
 - e. Each refrigeration circuit shall be equipped with expansion valve type refrigerant flow control.
 - f. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides and a factory installed liquid line filter driers.
 - g. Unit shall include a variable capacity scroll compressor on the lead refrigeration circuit which shall be capable of modulation from 10-100% of its capacity and an on/off compressor on the lag refrigeration circuit.

- h. Unit shall include factory provided and installed compressor sound jackets on all compressors.
 - i. Lead refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space.
7. Condensers
- a. Air-Cooled Condenser
 - 1) Condenser fans shall be a vertical discharge, axial flow, direct drive fans.
 - 2) Coils shall be designed for use with R-454b refrigerant. Coils shall be multi-pass and fabricated from aluminum microchannel tubes.
 - 3) Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.
 - 4) Coils shall be hydrogen or helium leak tested.
 - 5) Condenser fans shall be high efficiency electrically commutated motor driven with factory installed head pressure control module. Condenser airflow shall continuously modulate based on head pressure and cooling operation shall be allowed down to 35°F with adjustable compressor lockout.
8. Filters
- a. Unit shall include 2 inch thick, pleated panel filters with an ASHRAE MERV rating of 8, upstream of the cooling coil.
9. Outside Air/Economizer
- a. Unit shall include 0-100% economizer consisting of a motor operated outside air damper and return air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 20 cfm of leakage per sq ft. at 4 in. w.g. air pressure differential across the damper. Low leakage dampers shall be Class 2 AMCA certified, in accordance with AMCA Standard 511. Damper assembly shall be controlled by spring return actuator. Unit shall include outside air opening bird screen, outside air hood, and relief dampers.
10. Controls
- a. Controls shall be field provided & installed by temperature controls contractor.
- H. Curbs
- 1. Curbs shall be vibration isolating with spring dampers and spring access door.
- I. Installation, Operation, and Maintenance
- a. Installation, Operation, and Maintenance manual shall be supplied with the unit.
 - b. Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation, and Maintenance manual instructions.
 - c. Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.

2.12 DUCT MOUNTED HEATING COILS

- A. Contractor will furnish and install, where indicated on the plans, coils as described in the following specifications:
- B. Primary surface ½-inch & 5/8-inch OD seamless copper tube, of staggered configuration. Tubes will be mandrel expanded to ensure a permanent mechanical fin bond. Return bends will be die-formed and brazed to tubes.
- C. Extended surface will consist of die-formed continuous aluminum fins with formed channels and surface treatment to minimize moisture carryover. Fins will have fully-drawn collars to accurately space fins, and to form a protective sheath for the primary surface. Face velocity for coils condensing moisture will not exceed 600 fpm.
- D. Casing will be constructed of galvanized for HW coils and stainless steel for CW & DX coils to protect the coil during shipment and stacking of coils. Tube sheets on each end will have

drawn collars to support tubes. A single intermediate coil support will be provided on coils with a finned length of more than 62 inches, two (2) intermediate supports above 100 inches in length, and three (3) intermediate supports on coils with a finned length of more than 141 inches. Casing channels will be free-draining, without depressions to collect moisture and contaminants. Casing channels will not block fin area.

- E. Certified in accordance with ARI Standard 410 for coil capacity and pressure drop. All coils will be circuited to operate at design load with water velocity within the ARI range of certified rating conditions.
- F. Headers will be of heavy seamless copper (or red brass) tubing silver-brazed to tubes. Connections will be of steel (or red brass) with male pipe threads silver brazed to headers. A ¼-inch FPT, plugged vent, or drain tap will be provided on each connection. All coils must have same-end connections, regardless of number of rows deep.
- G. Circuiting will be to provide free draining and venting, through one vent and one drain on each coil, when installed with casing level. Coils will be circuited, and have connections arranged for counter-flow of air and water, with supply on bottom and return on top of coil headers. Coil circuiting will provide for design water velocity in tubes without exceeding total water pressure drops in schedule.
- H. Testing will be performed on every coil. The completed coil, including headers, connections, and return bends, will be tested with 325 psig of compressed air under water. Coils will be designed for operation at 250 psig design working pressure and up to 300°F.

2.13 POWER ROOF VENTILATORS

- A. Furnish and install power roof ventilator where shown on the Drawings. Type, size, and performance shall be as tabulated in the schedule and on the drawings. Provide & install accessories as scheduled on the plans.
- B. Spun aluminum exhaust fans shall be belt or direct drive type. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure.
- C. Motors shall be heavy duty ball bearing type, carefully matched to the fan load, and furnished at the specified voltage, phase and enclosure. Drive frame assembly shall be constructed of heavy gauge steel. Motors and drives shall be constructed of heavy gauge steel. Motors and drives shall be mounted on vibration isolators, out of the air stream. Fresh air for motor cooling shall be drawn into the motor compartment through a large space between the fan shroud and the motor cover. Motors and drives shall be readily accessible for maintenance.
- D. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum (L10) life in excess of 100,000 hours at maximum cataloged operating speed. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the cast type, keyed and securely attached to the wheel and motor shafts.
- E. Motor pulleys shall be adjustable for final system balancing. A disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment. A conduit chase shall be provided through the base to the motor compartment for ease of electrical wiring.
- F. All fans shall bear the AMCA Certified Ratings Seal for sound and air performance. Each fan shall bear a permanently affixed manufacturer's engraved metal nameplate containing the model number and individual serial number for future identification.
- G. Provide and install options and accessories as described in schedule.
- H. All power roof ventilator exhaust fan drops to have fully insulated field installed 3" deep watertight drip pan.

2.1 CEILING EXHAUST FAN

- A. Furnish and install ceiling exhaust fan where shown on the Drawings. Type, size, and performance shall be as tabulated in the schedule and on the drawings.
- B. Fan shall be manufactured at an ISO 9001 certified facility. Fan shall be listed by Underwriters Laboratories (UL 705) and UL listed for Canada (CUL 705). Fan shall bear the AMCA certified ratings seal for sound and air performance.
- C. Wheel shall be centrifugal forward curved type, injection molded of polypropylene resin. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.
- D. Motor shall be open drip proof type with permanently lubricated sealed bearings and include impedance or thermal overload protection and disconnect plug. Motor shall be furnished at the specified voltage and phase.
- E. Provide options and accessories as described in Fan Schedule

2.2 INTAKE HOOD

- A. Furnish and install gravity hoods where shown on the Drawings. Type, size, and performance shall be as tabulated in the schedule and on the drawings.
- B. The shroud shall be constructed of heavy gauge aluminum with a formed edge for additional strength. Covers shall be detachable to gain access to dampers. A windband, standard bird screen and internal members shall be combined to form a rigid support. Unit shall feature one-piece curb to assure weather tightness.
- C. Provide & install accessories as scheduled on the plans.
- D. Send 3 hard copies of color charts to architect during shop drawings for color selection by architect.
- E. This contractor to provide and install minimum 18" tall insulated roof curb, roofing work by roofing contractor.

2.3 FIRE DAMPERS

- A. Fire Dampers meeting the following specifications shall be furnished and installed where shown on plans.
- B. Fire Dampers:
 - 1. Fire dampers shall meet requirements in accordance with NFPA 80, 90A, and 101. Fire dampers shall be tested, rated and labeled in accordance with UL555. This model carries a 1 1/2 hour UL fire damper rating.
 - 2. Dampers shall be constructed of 2.188 in. galvanized steel frame, galvanized curtain style blades in gauges required by UL listing R13317. Each fire dampers shall be equipped with a factory installed heat responsive device, fusible link, rated to close the damper when temperature at the dampers reaches 165 F. Dampers shall have a minimum UL555 differential pressure rating of 4 in. wg and minimum velocity rating of 2,000 ft/min.
- C. Requirements for an approved installation include the following:
 - 1. Openings in wall shall be 1/4" to 1/2" larger than overall size of fire damper and sleeve assembly.
 - 2. Sleeve gauge shall be at least equal to the gage of the duct as defined by the appropriate SMACNA Duct Construction Standard, as described in NFPA90A, when one or more of the following Duct Sleeve Connections are used (Plain S Slip, Hemmed S Slip, Standing S Slip, Reinforced Standing S Slip, Inside Slip Joint, Double S Slip).
 - 3. If any other Duct Sleeve Connections are used, the sleeve shall be a minimum 16 gauge for dampers up to 36"W x 24"H and 14 gauge if width exceeds 36" or height exceeds 24".
 - 4. Mounting angles shall be minimum of 1-1/2" x 1-1/2" x 14 gauge and bolted, tack welded or screwed to sleeve at max spacing of 12" and with minimum of two connections in each

side, top, and bottom. Mounting angles shall overlap wall a minimum of one inch on all four sides.

5. Damper shall be bolted, tack welded or screwed to sleeve on same spacing as angles. Sleeves shall not extend more than 6 inches outside of wall or floor.
6. Provide tight fitting access doors in ductwork at each damper – sized and located so that damper can be readily reset. Service openings shall be identified with stenciled letters no less than ½” in height to indicate the location of the fire protection devices.

2.4 REGISTERS, GRILLES, AND DIFFUSERS

- A. Furnish and install registers, grilles, and diffusers where shown on the Drawings. Type, size, and performance shall be as tabulated in the schedule and on the drawings. Provide & install accessories as scheduled on the plans.
- B. Provide and install options and accessories as described in schedule.

2.5 MOTORIZED CONTROL DAMPER

- A. Furnish and install, as shown on plans, Ruskin CD-50 low leakage damper OR equal.
- B. Damper blade shall be of not less than 16 gauge galvanized steel formed for strength and high velocity performance with closed-cell neoprene edging. Damper blades shall not exceed 8 inches in width. Blades shall be secured to ½ inch diameter zinc plated axles by zinc plated bolts and nuts. All blade bearings shall be nylon. Blade side edges shall seal off against spring stainless steel seals. Teflon coated thrust bearings shall be provided at each end of every blade to minimize torque requirements and ensure smooth operation. All blade linkage hardware shall be constructed of corrosion resistant, zinc plated steel and brass. Dampers shall be suitable for operation within the following temperature limits, -40 degrees to 200 degrees F. and have a maximum leakage of 6 cfm per square foot at 4” water gauge.
- C. Combustion air dampers for shall be 24V normally closed spring return.
- D. FC-1 dampers shall be 24V, see plans for normal position spring return.
- E. Provide & install accessories as scheduled on the plans.

2.6 THROWAWAY FILTERS

- A. Provide one additional set of throwaway filters for the entire system. Furnish and install throwaway type filters for air handling systems and return grilles, 1 or 2-inch thick disposable type, ASHRAE 52.1, U.L. Class 2, 30% Efficient MERV 8, filters as manufactured by Flanders Airpure, American Air Filter, Farr, Cambridge, or equal where shown on the Drawings.
- B. Provide entire system with one additional set of disposable filters for the owner’s use.

2.7 AUTOMATIC TEMPERATURE CONTROL

- A. Install the automatic temperature control dampers, air flow monitoring devices, openings for air flow switches, alarms and control devices as provided by the Automatic Temperature Control Contractor. These dampers and devices shall be installed under the direct supervision of the Section 23 0900, CONTROLS & CONTROL SEQUENCES Temperature Control Contractor and in strict accordance with the manufacturer’s recommendations.

2.8 SPARE PARTS

- A. Provide all air handlers, fan coils, and packaged rooftop units with one additional set of disposable filters.

END OF SECTION 23 7000

TABLE OF CONTENTS

<u>SECTION</u>	<u>DESCRIPTION</u>	
26 0500	COMMON WORK RESULTS FOR ELECTRICAL SYSTEMS	1-11
26 0510	MINOR ELECTRICAL DEMOLITION	1-2
26 0519	LOW VOLTAGE ELECTRICAL CONDUCTORS AND CABLES	1-6
26 0526	GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS	1-5
26 0529	HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS	1-5
26 0533	RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS	1-10
26 0553	IDENTIFICATION FOR ELECTRICAL SYSTEMS	1-6
26 0923	LIGHTING CONTROL DEVICES	1-4
26 2416	PANELBOARDS	1-8
26 2726	WIRING DEVICES	1-6
26 2816	ENCLOSED SWITCHES AND CIRCUIT BREAKERS	1-6
26 5119	LED LIGHTING	1-6
27 0500	COMMON WORK RESULTS FOR COMMUNICATIONS	1-2
27 1100	COMMUNICATIONS EQUIPMENT ROOM FITTINGS	1-6
27 1500	COMMUNICATIONS HORIZONTAL CABLING	1-11
28 0500	COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY	1-3
28 0513	CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY	1-10
28 3111	DIGITAL, ADDRESSABLE FIRE ALARM SYSTEM	1-13

**SECTION 260500
COMMON WORK RESULTS FOR ELECTRICAL**

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 & 01 Specification Sections, apply to this Section. Any Contractor/Supplier who submits a bid, enters into a contract and/or provides work described in this Section acknowledges that they have read and comprehend all Sections within Division 00 & 01 and that this Specification Section.

- B. Description:
 - 1. Basic electrical requirements.

- C. Work Included:
 - 1. Coordination and installation.
 - 2. Complete electrical power system including light fixtures, equipment, motors, outlets, etc.
 - 3. Complete fire alarm system.
 - 4. Communications wiring and conduit.
 - 5. Removal work and/or relocation and reuse of existing systems and equipment.

- D. Work Not Included:
 - 1. Wiring of equipment.
 - 2. Temperature control wiring for plumbing, heating, and air-conditioning equipment (unless otherwise indicated) will be by other Contractors.

1.2 REFERENCES

- A. See Section 01 4200 – References, for all Abbreviations, Acronyms, ANSI & ASTM standards, Specialty Codes and Trade Practices that are referenced herein.

- B. Abbreviations and Acronyms listed
 - 1. NECA National Electrical Contractors Association

- C. Definitions:
 - 1. See Section 01 4200 – References, for universal definitions related to the Work.
 - 2. "Mechanical Contractor" as referred to herein refers to the Contractors as follows:
 - a. Plumbing Contractor.
 - b. HVAC Contractor.
 - c. Fire Protection Contractor.
 - 3. Motor Power Wiring. The single phase or 3 phase wiring extending from the power source (transformer, panelboard, feeder circuits, etc.) through disconnect switches and motor controllers to, and including the connections to the terminals of the motor.
 - 4. Motor Control Circuit Wiring. The wiring associated with the remote operation of the magnetic coil of magnetic motor starter or relay, or the wiring which permits the direct cycling of the motor by means of a device in series with the motor power wiring. In the latter case the devices are usually single phase, have "Manual-Off-Auto" provisions, and are usually (but not always) connected into the motor power wiring through a manual motor starter.
 - 5. Control devices such as start-stop push buttons, thermostats, pressure switches, flow switches, other relays, etc. generally represent the type of equipment associated with motor control circuit wiring.

6. Motor control circuit wiring is single phase and usually will be 120 volts. In some instances, the voltage will be the same as the motor power wiring. Generally, where the motor power wiring exceeds 120 volts, a control transformer is provided to give a control voltage of 120 volts.
7. Temperature Control Wiring: The wiring associated with the operation of a motorized damper, solenoid valve or motorized valve, etc., either modulating or two (2) position, as opposed to wiring which directly powers or controls a motor used to drive equipment such as fans, pumps, etc.
8. Control Motor: Where the term "Control Motor" is used without other clarification, it means an electrical device used to operate dampers, valves, etc. It may be of such a design to produce two position or modulating operation of the operated device. Conventional characteristics of such a motor are 24 volts, 60 cycles, 1 phase, although other voltages at times may be encountered.

1.3 QUALITY ASSURANCE

- A. See Section 01 4000 – Quality Requirements, for general quality criteria that the Work shall fulfill.
- B. Work to Conform to:
 1. This Specification and the accompanying drawings govern the work involved in furnishing, installing, testing and placing into satisfactory operation the Electrical Systems as shown on the drawings and specified herein.
 2. Each Contractor shall provide and install new materials as indicated in the schedules on the Drawings and/or in these Specifications, and all items required to make their portion of the electrical system a finished and working system.
 3. NECA 1 – Standard Practices for Good Workmanship in Electrical Construction.
 4. Materials:
 - a. See additional requirements which may be listed under Division 1 of this Specification.
 - b. Where several manufacturer's names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required to be used in this contract.
 - c. This Contractor, at his option, may use equivalent equipment as manufactured by the other named manufacturers. This Contractor is responsible to ensure that all items submitted by these other manufacturers meets all requirements of the drawings and specifications and fits in the allocated space. The final determination of a product being equivalent shall be determined by the Engineer when a catalog number is not listed or listed in part.
 - d. Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Architect/Engineer not later than ten (10) days prior to the bid opening date.
 - e. This Contractor may list voluntary add or deduct prices for alternate materials on the bid form. These items will not be used in determining the low bidder. Should a voluntary alternate material be accepted, This Contractor shall assume all costs that may be incurred as a result of using the offered material, article, or equipment necessitating extra expense on his part or on the part of other Contractors whose work is affected.
 - f. All material substitutions requested later than ten (10) days prior to bid opening may be listed as voluntary changes on the bid form and shall be treated as voluntary prices as described above.
- C. Qualifications:
 1. Only products of reputable manufacturers as determined by the Engineer will be acceptable.
 2. Each Contractor and his subcontractors shall employ only workmen who are skilled in their respective trades. At all times, the number of apprentices at the job site shall be less than or equal to the number of journeymen at the job site.

D. Warranty

1. Provide one (1) year warranty for all fixtures, equipment, materials and workmanship.
 - a. For Owner furnished equipment, Contractor shall be responsible for any labor associated with warranty issues and will work directly with the Supplier for warranty claims on the materials.
 - b. Contractor shall also include one (1) additional year of support to provide labor as required to INVESTIGATE issues that might arise after the initial one-year warranty.
2. The warranty period for the entire installation described in this Division of the specifications shall commence on the date of final written acceptance unless a whole or partial system or any separate piece of equipment or component is put into use for the benefit of any party other than the installing contractor with prior written authorization. In this instance, the warranty period shall commence on the date when such whole system, partial system, or separate piece of equipment or component is placed in operation and accepted in writing by the Owner or his representative.
3. Warranty requirements shall extend to correction, without cost to the final use, of all Work and/or equipment found to be defective or non-conforming to the contract documents. The Contractor shall bear the cost of correcting all damage resulting from such defects or nonconformance with contract documents exclusive of repairs required as a result of improper maintenance or operation, or of normal wear as determined by the Architect/Engineer.

E. Compliance with Codes, Laws, Ordinances:

1. This Contractor shall conform to all requirements of local codes, laws, ordinances and other regulations having jurisdiction over this installation.
2. In the event there are no local codes having jurisdiction over this job, the current issue of the National Electrical Code shall be followed.
3. If there is a discrepancy between the codes and regulations having jurisdiction over the installation, and these specifications, the codes and regulations shall determine the method or equipment used.
4. If the Contractor notes, at the time of bidding, any parts of the drawings and specifications which are not in accord with the applicable codes or regulations, he shall inform the Architect/Engineer in writing, requesting a clarification. If there is insufficient time to follow this procedure, he shall submit with his proposal a separate price required to make the system shown on the drawings comply with the codes and regulations.
5. All changes to the system made after the letting of the contract, in order to comply with the applicable codes or the requirements of the Inspector, shall be made by the Contractor without cost to the Owner.

F. Permits, Fees, Taxes, Inspections:

1. Procure all applicable permits and licenses.
2. Abide by all applicable laws, regulations, ordinances, and other rules of the State or Political Subdivision wherein the work is done, or as required by any duly constituted public authority.
3. Pay all applicable charges for such permits or licenses that may be required.
4. Pay all applicable fees and taxes imposed by the State, Municipal and/or other regulatory bodies.
5. Pay all charges arising out of required inspections by the codes, permits, licenses or otherwise may be required by an authorized body.
6. Pay any charges by the telephone company related to the service or change in service to the project.
7. All fixtures, equipment, and materials shall be as approved or listed by the following: (Unless approval or listing is not applicable to an item by all acceptable manufacturers.)
 - a. Factory Mutual
 - b. Underwriters' Laboratories, Inc.

G. Utility Company Requirements:

1. Secure from the appropriate utility company all applicable requirements that must be followed to make the job comply with their requirements.
2. Make the installation comply with the utility company requirements.

H. Examination of Drawings:

1. The drawings for the electrical work are completely diagrammatic, intended to convey the scope of the work and to indicate the general arrangements and locations of equipment, outlets, etc., and the approximate sizes of equipment.
2. Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of electrical raceways so as to best fit the layout of the job.
3. Scaling of the drawings will not be sufficient or accurate for determining these locations.
4. Where job conditions require reasonable changes in indicated arrangements and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
5. Because of the scale of the drawings, certain basic items, such as a junction boxes, pull boxes, conduit fittings, etc. may not be shown, but where such items are required by other sections of the specifications or where they are required for proper installation of the work, such items shall be furnished and installed.
6. If any item is either shown on the drawings or called for in the specifications, it shall be considered sufficient for including same in this contract.
7. The determination of quantities of material and equipment required shall be made by the Contractor from the drawings. Schedules on the drawings and in the specifications are completed as an aid to the Contractor but where discrepancies arise, the greater number shall govern.

I. Field Measurements:

1. Before ordering any conduit, conductors, wireways, bus duct, fittings, etc., this Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.
2. Field verify quantities of all light fixtures and compare / coordinate with fixture supplier.

J. Coordination and Pre-Installation Meeting

1. Per Section 01 3100 – Project Management and Coordination.
2. Conduct pre-installation meeting one week before installation.
 - a. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1) To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2) To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3) To allow right of way for piping and conduit installed at required slope.
 - 4) So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
 - b. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

K. Division of Work between Mechanical, Electrical, and Control Contractors

1. The purpose of these Specifications is to outline the Electrical and Mechanical Contractor's work responsibilities as related to control wiring, starters, disconnects and other electrical work required for items such as temperature controls, mechanical equipment, fans, chillers, compressors, etc. The exact wiring requirements for much of the equipment cannot be determined until the systems have been purchased and submittals approved. Therefore, only known wiring, as related to such items, is shown on the electrical drawings as being by the Electrical Contractor. Other wiring not shown on the electrical drawings but required for the mechanical equipment and systems shall be the responsibility of the Mechanical Contractor.

2. Where the drawings require the Electrical Contractor to wire between various pieces of equipment furnished by the Mechanical Contractor, such wiring shall be terminated at terminals provided in the equipment. It is the Mechanical Contractor's responsibility to provide complete wiring diagrams and supervision to the Electrical Contractor and to designate the terminal numbers for the correct wiring of the equipment.
3. Mechanical Contractor's Responsibility:
 - a. Assumes all responsibility for the internal wiring of all equipment provided by the Mechanical Contractor, for example:
 - 1) Sump Pumps
 - 2) Package Air Handling Units
 - 3) Humidifiers
 - b. Assumes all responsibility for miscellaneous items provided by the Mechanical Contractor that require wiring but are not shown on the electrical drawings or specified in the Electrical Specification. If items such as relays, flow switches, or interlocks are required to make the mechanical system function correctly or are required by the manufacturer, they are the responsibility of the Mechanical Contractor.
 - c. Assumes all responsibility for the Temperature Control wiring, if the Temperature Control contractor is Subcontractor to the Mechanical Contractor.
4. Temperature Control Subcontractor's Responsibility:
 - a. Assumes all responsibility for the complete wiring of any devices necessary to make the Temperature Control System functional.
 - b. Assumes the responsibility for verifying any control wiring shown on the electrical drawings as being by the Electrical Contractor. If any wiring is required for the Control System, but not shown or scheduled on the electrical drawings, it shall be the responsibility of the Temperature Control Subcontractor.
 - c. Assumes the responsibility of coordinating equipment locations (such as P.E.'s, E.P.'s, relays, transformer and etc.) with the Electrical Contractor where the wiring of the equipment is shown to be by the Electrical Contractor.
5. Electrical Contractor's Responsibility:
 - a. Furnishes and installs all combination starters as shown on the Material's List of the Electrical Drawings or as indicated to be by the Electrical Contractor on the Mechanical Equipment Schedule of the Mechanical Drawings.
 - b. Furnishes and installs all manual starters and disconnect devices as shown on the Material's List of the Electrical Drawings or as indicated to be by the Electrical Contractor on the Mechanical Equipment Schedule of the Mechanical Drawings.
 - c. Installs and wires to all remote control devices furnished by the Mechanical Contractor or Temperature Control Subcontractor when such items are noted on the Electrical Drawings.
 - d. Provides motor control wiring where so noted on the drawings.
 - e. Provides temperature control wiring where so noted on the drawings.
 - f. Electrical Contractor shall furnish, install, and connect all relays, etc., for automatic shutdown of certain mechanical equipment (i.e. supply fans, exhaust fans, etc.) upon actuation of the Fire Alarm System.

1.4 SUBMITTALS

- A. All submittals under the provisions of Section 01 3300 – Submittal Procedures, unless noted otherwise. Refer to Section 01 3300 – Submittal Procedures, Paragraph 3.1, for descriptions of submittal items. Submittals listed below are required:
 1. Product Data: For high-pressure decorative laminate, cabinet hardware and accessories, and finishing materials and processes.
 2. Shop Drawings:

- a. Submittals shall include all fabrication, erection, layout, and setting drawings; manufacturers' standard drawings; schedules; descriptive literature, catalogs and brochures; performance and test data; wiring and control diagrams; and all other drawings and descriptive data of materials of construction as may be required to show that the materials, equipment or systems and the location thereof conform to the requirements of the contract documents.
- b. Shop drawings shall establish the actual detail of all manufactured or fabricated items and shall indicate proper relation to adjoining work in sufficient detail to assure proper fit to the actual conditions. As used hereinbefore the term "manufactured" applies to standard units usually mass produced and "fabricated" applies to items specifically assembled or made out of selected materials to meet design requirements.
- c. The Contractor shall obtain submittals successfully reviewed by the Architect/Engineer BEFORE releasing any equipment for manufacturing or shipment. The Architect/Engineer will stamp the index indicating review has been completed. No less than one copy of the submittals shall be retained by the Architect/Engineer regardless of their status. The following criteria shall be met:
 - 1) Shop drawings shall be submitted electronically by the Contractor as directed by the Construction Manager via Submittal Exchange. The Contractor shall work directly with the supplier of Owner furnished equipment to obtain and submit shop drawings for such equipment.
 - 2) Each submittal shall be assembled in sets containing similar type equipment. As applicable to this project, typical sets shall include: (This list is not to indicate the requirement to submit all listed items. See elsewhere in contract documents for required submittals.
 - a) All light fixtures including emergency and exit.
 - b) All panelboards, switchboards, switchgear, fuses, breakers, disconnect switches, motor control centers, manual motor starters, motor starters, termination bushings, transformers, pushbuttons and other switches (when part of motor control), pilot lights, and miscellaneous motor control and distribution equipment.
 - c) All variable frequency drives.
 - d) All generators, uninterruptible power supplies, and transfer switches.
 - e) All fire alarm components: smoke detectors, heat detectors, pull stations, audio devices, visual devices, annunciators, control panels, flashing devices, door hold-opens, auxiliary relays and other auxiliary devices.
 - f) All lightning protection components.
 - g) All intercommunication and miscellaneous systems components.
 - h) Other items as dictated elsewhere in the contract documents.
- d. Each page shall be clearly marked with the same nomenclature used on the contract documents (specifications or drawings). The nomenclature shall be the same as the symbol designation or item number used on the material list when applicable. Each item shall clearly indicate the size, finish, material, voltage, etc. Shop drawings shall be custom produced and shall not be a reproduction, copy or tracing of the contract documents, either in full or in part.
- e. Each bound set of shop drawings shall contain a double-spaced typed index of items enclosed to include the nomenclature as described above. Items required to have color or finish verified with the Architect/Owner shall have the status of the verification noted on the index.
- f. The Contractor shall review and approve all shop drawings by signing and dating the index of each copy prior to the Architect/Engineer review. APPROVAL WILL INDICATE THE CONTRACTOR'S PREVIEW OF ALL MATERIAL AND A COMPLETE UNDERSTANDING OF EXACTLY WHAT IS TO BE FURNISHED. REVIEW WILL NOT BE INITIATED BY ARCHITECT/ENGINEER WITHOUT PRIOR APPROVAL NOTED BY CONTRACTOR'S STAMP.

- g. Each page of the submittal, including the index, shall display the date of the current submittal. The index shall contain a clear white area no less than 3" X 4" available for the Architect's/Engineer's stamp. Items required for re-submittal will be noted on the index. Items noted for re-submittal shall not be considered successfully reviewed and shall not be released for manufacturing or shipment. Re-submittals shall be assembled as outlined above and shall contain only the items noted in the previous submittal.
 - h. Notations made on the shop drawings during the Architect's/Engineer's review does not relieve the Contractor from compliance with the requirements of the drawings and specifications. The Architect's/Engineer's review is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. The Contractor is responsible for confirming and correlating all quantities and dimensions, providing all specified accessories, selecting fabrication processes and techniques of construction, coordinating his work with that of all other trades, and performing his work in a safe and satisfactory manner.
- 3. Failure to comply with any of the above shall be reason for the Architect/Engineer to require re-submittal of the set. Shop drawings returned for re-submittal two (2) times shall have all additional Architect's/Engineer's times paid by the Contractor to complete proper review of the submittal.
 - 4. Installation, maintenance and operation manuals and instructions for all equipment shall be provided as specified in the General Conditions and General Requirements section.
 - 5. Submittals shall be required for each item listed on the contract documents' material list and any other material specifically requiring submittal by the specification and/or drawings.
 - 6. Items submitted for review which were not requested by the Contract Documents shall be marked "Receipt Acknowledged" and returned to the Contractor. Submittal shall not be reviewed, but shall remain in Architect/Engineer's files for reference should questions relating to submittal occur during construction.

1.5 PRODUCT DELIVERY, STORAGE, HANDLING AND MAINTENANCE

- A. Exercise care in transporting and handling to prevent damage to fixtures, equipment and materials.
- B. Store materials on the site so as to prevent damage.
- C. Keep fixtures, equipment and materials clean, dry and free from deleterious conditions.
- D. Contractor shall coordinate delivery and receiving of all Owner furnished equipment with Supplier. Contractor shall be responsible for receiving all Owner furnished products at the job site and verifying there are no damages or shortages. Any discrepancies shall be reported directly to the Supplier.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All items of material having similar function (i.e. safety switches, panelboards, switchboards, contactors, motor starters, dry type transformers), shall be of the same manufacturer. This shall be adhered to unless specifically stated otherwise on drawings or elsewhere in specifications.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

- C. Coordinate mounting heights and locations of wall-mounted devices with Architectural millwork, displays, tackboards, etc.
- D. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- E. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- F. Right of Way: Give to piping systems installed at a required slope.

3.2 FIELD QUALITY CONTROL

A. General:

1. The Contractor shall conduct all tests required and applicable to the work both during and after construction of the work.
2. The necessary instruments, meters, etc., required to conduct or make the tests shall be supplied by the Contractor who shall also supply a competent technician for making the tests who has been schooled in the proper testing techniques.
3. All cables and wires shall be tested for shorts and grounds following installation and connection to devices. Shorted or grounded wires and cables shall be removed and replaced.
4. Each circuit installed by Contractor over 100' in length shall have the most distant outlet or load tested for voltage drop under full load conditions. Full load for outlet(s) shall be determined by multiplying the upstream overcurrent device by 80 percent and applying the calculated load to the most distant location of the circuit. Full load for equipment shall be equipment operation at full output. The Contractor shall increase wire size of circuit until voltage drop is below 3% of rated voltage. The Contractor shall provide a load bank to perform tests.
5. Any wiring device, electrical apparatus or lighting fixture furnished under this contract, if grounded or shorted on any integral "live" part, shall be removed and the trouble rectified by replacing all defective parts or materials as directed.
6. Cable insulation shall be tested for proper insulation values. Such tests shall include the cable, all splices, and all terminations. Each conductor shall be tested and shall test free from short circuits and grounds and have an insulation value not less than the National Electrical Code Standards. Readings shall be taken between conductors and between conductors and ground.
7. A record of readings taken shall be supplied to the Architect/Engineer in a neat and understandable form and in triplicate. The record shall include: circuit designation, ampere loading, voltage at circuit overcurrent device, and voltage at circuits extremity under full load as calculated in previous paragraph.
8. In the event the results obtained in the tests are not satisfactory, This Contractor shall make such adjustments, replacements and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment, and shall make such additional tests as the Architect/Engineer or code enforcing agency deems necessary.

B. Other Equipment:

1. Other equipment furnished and installed by the Contractor shall be given all standard tests normally made to assure that the equipment is electrically sound, all connections properly made, phase rotation correct, fuses and thermal elements suitable for protection against overloads, etc., voltage complies with equipment nameplate rating and full load amperes are within equipment rating.
2. In the event the results obtained in the tests are not satisfactory, the Contractor shall make such adjustments and changes as are necessary and shall then repeat the test or tests which disclose faulty or defective work or equipment, and shall make such additional tests as the Architect/Engineer or code enforcing agency deems necessary.

3.3 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.4 INSTRUCTING THE OWNER'S REPRESENTATIVE

- A. Adequately instruct the Owner's designated representative or representatives in maintenance, care, and operation of the complete electrical systems installed under this contract. Adequate instructions shall include the following:
 - 1. Three properly indexed and bound copies of record shop drawings including catalog and engineering data, as hereinafter defined, for all items of electrical equipment supplied.
 - 2. Three (3) properly indexed and bound copies of written instructions for the care, maintenance, and operation of the electrical equipment and systems. Instruction books, cards, and manuals furnished with the equipment shall be included.
 - 3. Provide verbal and written instructions to the Owner's representative or representatives by FACTORY PERSONNEL in the care, maintenance, and operation of the equipment and systems. The instructions shall be as long and often as necessary for the user agency to adequately understand the electrical system.
- B. The Architect/Engineer shall be notified of the time and place for the verbal instructions to be given to the Owner's representative so that either he or his representative can be present if desirable.
- C. Before the final payment will be authorized, This Contractor must have submitted the following for approval and disposition:
 - 1. The bound copies of shop drawings.
 - 2. The bound copies of written instructions for the care, maintenance, and operation of the electrical equipment.
 - 3. A report stating the instructions given to the Owner's representative complete with the number of hours spent in the instruction. The report shall bear the signature of an authorized agent of This Contractor and shall be signed by the Owner's representative as having received the instructions.
 - 4. The name, address, and telephone numbers of The Contractor and all Subcontractors shall be included as part of the bound copies of Shop Drawings.

3.5 SYSTEM COMMISSIONING

- A. The electrical systems included in the construction documents are to be complete and operating systems. The Architect/Engineer will make periodic job site observations during the construction period. The system start-up, testing, balancing, and satisfactory system performance is the responsibility of the Contractor. This shall include all calibration and adjustments of electrical equipment controls, balancing of loads, and final adjustments that may be required.
- B. All operating conditions and control sequences shall be simulated and tested during the start-up period. Testing shall also include all interlocks, safety shut-downs, system operations, and alarms.
- C. The Contractor, subcontractors, and equipment suppliers are expected to have skilled technicians to ensure that the system performs as designed. If the Architect/Engineer is requested to visit the job site for the purpose of trouble shooting, assisting in the satisfactory start-up, obtaining satisfactory equipment operation, resolving installation and/or workmanship problems, equipment substitution issues or unsatisfactory system performance, including call backs during the warranty period through no fault of the design; the Contractor shall reimburse the Architect/Engineer on a time and material basis for services rendered at the Architect/Engineer's standard hourly rates in effect at the time the services are requested. The Contractor shall be responsible for making payment to the Architect/Engineer for services required that are product, installation or workmanship related. Payment is due within 30 days after services are rendered.

3.6 RECORD DRAWINGS

- A. This Electrical Contractor shall maintain at the job site a separate and complete set of electrical drawings upon which he shall clearly and permanently mark and note in complete detail any changes made to the location and arrangement of the electrical apparatus or made in the electrical system and wiring as a result of building construction conditions or as a result of instructions from the Architect/Engineer.
- B. Such record of changes shall be made daily by This Contractor and the marked drawings shall be available for the Architect and Engineer's examination at any normal work time.
- C. Upon completion of the job, and before final payment is made, This Contractor shall give the marked-up drawings to the Architect/Engineer.

3.7 PAINTING

- A. This Contractor shall paint any equipment which is marred or damaged prior to the Owner's acceptance and occupancy. Paint and color shall match original equipment paint and shall be obtained from the equipment supplier when available.
- B. Equipment located in finished areas and which will be painted to match the room decor will be painted by others. Should This Contractor install equipment in a finished area after the area has been painted by others, he shall be responsible for having the equipment and all of the supports, hangers, etc., painted to match the room decor at the Contractor's expense. Painting shall be performed as described in project specifications.
- C. Equipment cabinets, casings, covers, metal jackets, etc., located in equipment rooms or concealed spaces, shall be furnished in standard or prime finish free from scratches, abrasions, chippings, etc.
- D. Equipment located in occupied spaces, or if standard to the unit, shall have a baked primer with baked enamel finish coat free from scratches, abrasions, chippings, etc. If color option is specified or color option given as standard to the unit, This Contractor shall, before ordering verify with the Architect/Engineer his color preference and shall furnish this color.
- E. This Contractor shall paint equipment located in unfinished areas such as boiler room, mechanical spaces, storage room, etc., furnished by him. If certain equipment is furnished with a factory coat of paint and enamel, it need not be painted, providing the factory applied finished is in no way marred or spattered. If so, the item or piece of equipment shall be refinished with the same paint or enamel that was factory applied.
- F. Electric conduits shall NOT be painted in crawl spaces, tunnels or spaces above suspended ceiling except that where conduit is in a damp location exposed threads at joints shall be given two coats of sealer after joint is made up.
- G. After surfaces have been thoroughly cleaned and are free of oil, dirt or other foreign matter, the raceway or equipment shall be painted with the following paint materials:
 - 1. Bare Metal Surfaces – Apply one coat of metal primer suitable for use on metal being painted. Finish with two coats of Alkyd base enamel paint.
 - 2. Plastic Surfaces – Paint plastic surfaces with two coats of semi-gloss acrylic latex paint.

3.8 POST-INSTALLATION REQUIREMENTS

- A. Clean the Work and affected adjacent materials per the manufacturer's written instructions.
 - 1. Clean all equipment and systems prior to the Owner's final acceptance of the project.
 - 2. Clean all foreign paint, grease, oil, dirt, labels, stickers, and other foreign material from equipment and fixtures.

- B. Protect the Work per Section 01 4000 – Quality Requirements, Article 3.5 Protection.
- C. Dispose of and manage construction waste per Section 01 7419 – Construction Waste Management.

END OF SECTION

**SECTION 260510
MINOR ELECTRICAL DEMOLITION FOR REMODELING**

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 & 01 Specification Sections, apply to this Section. Any Contractor/Supplier who submits a bid, enters into a contract and/or provides work described in this Section acknowledges that they have read and comprehend all Sections within Division 00 & 01 and that this Specification Section.
- B. Work Included:
 - 1. Coordination and installation.
 - 2. Electrical demolition and extension.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual Sections.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Before installation, verify substrate and adjoining work is ready to receive installation of the Work under this Section, per Section 01 4000 – Quality Requirements, Article 3.3 Inspections.
- B. Verify field measurements and circuiting arrangements are as shown on Drawings.
- C. Verify that abandoned wiring and equipment serve only abandoned facilities.
- D. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Architect/Engineer before disturbing existing installation.
- E. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- B. Coordinate utility service outages with Utility Company.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction.
- D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 24 hours before partially or completely disabling system. Minimize outage duration.
- E. Existing Fire Alarm System: Maintain existing system in service until new system is accepted. Disable system only to make switchovers and connections. Notify Owner and local fire service at least 24 hours before partially or completely disabling system. Minimize outage duration.

- F. Existing Communication Systems: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Notify Owner and Telephone Utility Company at least 24 hours before partially or completely disabling system. Minimize outage duration.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Remove, relocate, and extend existing installations to accommodate new construction.
- B. Remove abandoned wiring to source of supply.
- C. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
- E. Disconnect and remove abandoned panelboards and distribution equipment.
- F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- G. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- H. Repair adjacent construction and finishes damaged during demolition and extension work.
- I. Maintain access to existing electrical installations which remain active. Modify installation or provide access panel as appropriate.
- J. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.4 POST-INSTALLATION REQUIREMENTS

- A. Clean the Work and affected adjacent materials per the manufacturer's written instructions.
 - 1. Clean and repair existing materials and equipment which remain or are to be reused.
 - 2. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
 - 3. Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps and broken electrical parts.
- B. Protect the Work per Section 01 4000 – Quality Requirements, Article 3.5 Protection.
- C. Dispose of and manage construction waste per Section 01 7419 – Construction Waste Management.

END OF SECTION

SECTION 260519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 & 01 Specification Sections, apply to this Section. Any Contractor/Supplier who submits a bid, enters into a contract and/or provides work described in this Section acknowledges that they have read and comprehend all Sections within Division 00 & 01 and that this Specification Section.
- B. Work Included:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.
 - 3. Sleeves and sleeve seals for cables.
- C. Related Sections include the following:
 - 1. Section 27 1500 - Communications Horizontal Cabling, for cabling used for voice and data circuits.

1.2 REFERENCES

- A. See Section 01 4200 – References, for all Abbreviations, Acronyms, ANSI & ASTM standards, Specialty Codes and Trade Practices that are referenced herein.
- B. Definitions:
 - 1. See Section 01 4200 – References, for universal definitions related to the Work.
 - 2. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. Abbreviations and Acronyms listed
 - 1. NEMA National Electrical Manufacturers Association
 - 2. NETA InterNational Electrical Testing Association
 - 3. NFPA National Fire Protection Association
- D. ASTM standards listed
 - 1. ASTM A 53/A 53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

1.3 QUALITY ASSURANCE

- A. See Section 01 4000 – Quality Requirements, for general quality criteria that the Work shall fulfill.
- B. Work to Conform to:
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 2. Comply with NFPA 70.
 - 3. Trade Practice Sections listed:
 - a. NEMA WC 70 – Power Cables Rated 2,000V or Less for the Distribution of Electrical Energy
 - b. NFPA 70 – National Electrical Code
 - c. UL 486A-486B – Wire Connectors

C. Coordination and Pre-Installation Meeting

1. Per Section 01 3100 – Project Management and Coordination.
2. Conduct pre-installation meeting one week before installation.
 - a. Coordinate sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

D. Warranty: Manufacturer's standard warranty.

1.4 SUBMITTALS

- A. All submittals under the provisions of Section 01 3300 – Submittal Procedures, unless noted otherwise. Refer to Section 01 3300 – Submittal Procedures, Paragraph 3.1, for descriptions of submittal items. Submittals listed below are required:
1. Product Data: For each type of product indicated.
 2. Field quality-control test reports.
 3. Warranty.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Alcan Products Corporation; Alcan Cable Division.
 2. American Insulated Wire Corp.; a Leviton Company.
 3. General Cable Corporation.
 4. Senator Wire & Cable Company.
 5. Southwire Company.
 6. Engineer Approved Equal.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN and SO.
- D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
 2. Hubbell Power Systems, Inc.
 3. O-Z/Gedney; EGS Electrical Group LLC.
 4. 3M; Electrical Products Division.
 5. Tyco Electronics Corp.
 6. Engineer Approved Equal.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.4 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Advance Products & Systems, Inc.
 2. Calpico, Inc.
 3. Metraflex Co.
 4. Pipeline Seal and Insulator, Inc.
 5. Engineer Approved Equal.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 2. Pressure Plates: Stainless steel. Include two for each sealing element.
 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Before installation, verify substrate and adjoining work is ready to receive installation of the Work under this Section, per Section 01 4000 – Quality Requirements, Article 3.3 Inspections.

3.2 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.3 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. All wiring methods must be approved by local Authority Having Jurisdiction.
- B. Service Entrance: Type THHN-THWN, single conductors in raceway.
- C. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- D. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-THWN, single conductors in raceway.
- E. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- F. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.

- G. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.
- H. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- I. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- J. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- K. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.4 INSTALLATION OF CONDUCTORS AND CABLES

- A. General: Install according to the manufacturer's written instructions/ recommendations approved during the shop drawing submittal process.
- B. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 26 0529 "Hangers and Supports for Electrical Systems."
- G. Identify and color-code conductors and cables according to Section 26 0553 "Identification for Electrical Systems."

3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

3.6 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 2. For sleeve rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both wall surfaces.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.7 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.8 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 2. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
 - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
 - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- C. Test Reports: Prepare a written report to record the following:
1. Test procedures used.
 2. Test results that comply with requirements.
 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace malfunctioning units and retest as specified above.

3.10 POST-INSTALLATION REQUIREMENTS

- A. Clean the Work and affected adjacent materials per the manufacturer's written instructions.
- B. Protect the Work per Section 01 4000 – Quality Requirements, Article 3.5 Protection.
- C. Dispose of and manage construction waste per Section 01 7419 – Construction Waste Management.

END OF SECTION

**SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 & 01 Specification Sections, apply to this Section. Any Contractor/Supplier who submits a bid, enters into a contract and/or provides work described in this Section acknowledges that they have read and comprehend all Sections within Division 00 & 01 and that this Specification Section.
- B. Description:
 - 1. Grounding systems and equipment.

1.2 REFERENCES

- A. See Section 01 4200 – References, for all Abbreviations, Acronyms, ANSI & ASTM standards, Specialty Codes and Trade Practices that are referenced herein.
- B. Abbreviations and Acronyms listed:
 - 1. ASTM American Society for Testing and Materials
 - 2. IEEE Institute of Electrical and Electronics Engineers
 - 3. NETA InterNational Electrical Testing Association
 - 4. NFPA National Fire Protection Association
- C. Definitions:
 - 1. See Section 01 4200 – References, for universal definitions related to the Work.

1.3 QUALITY ASSURANCE

- A. See Section 01 4000 – Quality Requirements, for general quality criteria that the Work shall fulfill.
- B. Work to Conform to:
 - 1. Trade Practice Sections listed
 - a. IEEE C2 – National Electrical Safety Code
 - b. IEEE 81 – Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System
 - c. NETA MTS – Standard for Maintenance Testing Specifications for Electrical Power Equipment and Systems
 - d. NFPA 70 – National Electrical Code
 - e. NFPA 70B – Recommended Practice for Electrical Equipment Maintenance
 - f. NFPA 780 – Standard for the Installation of Lightning Protection Systems
 - g. UL 96 – Standard for Lightning Protection Components
 - h. UL 467 – Grounding and Bonding Equipment
 - i. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - j. Comply with UL 467 for grounding and bonding materials and equipment.
 - 2. ASTM standards listed
 - a. ASTM B 3 – Standard Specification for Soft or Annealed Copper Wire
 - b. ASTM B 8 – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft

- C. Coordination and Pre-Installation Meeting
 - 1. Per Section 01 3100 – Project Management and Coordination.
 - 2. Conduct pre-installation meeting one week before installation.
- D. Warranty: Manufacturer's standard warranty.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 5. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Bare Grounding Conductor and Conductor Protector for Wood Poles:
 - 1. No. 4 AWG minimum, soft-drawn copper.
 - 2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir or cypress or cedar.
- D. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches in cross section, unless otherwise indicated; with insulators.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet in diameter.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Before installation, verify substrate and adjoining work is ready to receive installation of the Work under this Section, per Section 01 4000 – Quality Requirements, Article 3.3 Inspections.

3.2 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 4/0 AWG minimum.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors, except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- C. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- D. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- E. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

- A. General: Install according to the manufacturer's written instructions/ recommendations approved during the shop drawing submittal process.
- B. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- C. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- D. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.
 - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
 2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s).
 5. Substations and Pad-Mounted Equipment: 5 ohms.
 6. Manhole Grounds: 10 ohms.
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

3.6 POST-INSTALLATION REQUIREMENTS

- A. Clean the Work and affected adjacent materials per the manufacturer's written instructions.
- B. Protect the Work per Section 01 4000 – Quality Requirements, Article 3.5 Protection.
- C. Dispose of and manage construction waste per Section 01 7419 – Construction Waste Management.

END OF SECTION

**SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 & 01 Specification Sections, apply to this Section. Any Contractor/Supplier who submits a bid, enters into a contract and/or provides work described in this Section acknowledges that they have read and understand all the requirements of Division 00 & 01 and this Section.

- B. Work Included:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.2 REFERENCES

- A. See Section 01 4200 – References, for all Abbreviations, Acronyms, ANSI & ASTM standards, Specialty Codes and Trade Practices that are referenced herein.

- B. Definitions/ Acronyms:
 - 1. See Section 01 4200 – References, for universal definitions related to the Work.
 - 2. EMT: Electrical metallic tubing.
 - 3. IMC: Intermediate metal conduit.
 - 4. RMC: Rigid metal conduit.
 - 5. ASTM American Society for Testing and Materials
 - 6. AWS American Welding Society
 - 7. MFMA Metal Framing Manufacturers Association
 - 8. MSS Manufacturers Standardization Society of the Valve and Fittings Industry
 - 9. NECA National Electrical Contractors Association
 - 10. NFPA National Fire Protection Association
 - 11. SSPC The Society for Protective Coatings

1.3 QUALITY ASSURANCE

- A. See Section 01 4000 – Quality Requirements, for general quality criteria of the Work.

- B. Work to Conform to:
 - 1. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. Comply with NFPA 70.
 - 3. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
 - 4. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.
 - 5. ASTM standards listed
 - a. ASTM A 36/A 36M – Standard Specification for Carbon Structural Steel
 - b. ASTM A 325 – Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
 - c. ASTM A 780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
 - 6. Trade Practice Sections listed

- a. AWS D1.1/D1.1M – Structural Welding Code-Steel
 - b. MFMA-4 – Metal Framing Standards Publication
 - c. MSS SP-58 – Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation
 - d. MSS SP-69 – Pipe Hangers and Supports - Selection and Application
 - e. NECA 1 – Standard Practices for Good Workmanship in Electrical Construction
 - f. NECA 101 – Standard for Installing Steel Conduit (Rigid, IMC, EMT)
 - g. NFPA 70 – National Electrical Code
 - h. SSPC-PA 1 – Shop, Field, and Maintenance Painting of Steel
- C. Coordination and Pre-Installation Meeting
- 1. Per Section 01 3100 – Project Management and Coordination.
 - 2. Conduct pre-installation meeting one week before installation.
 - a. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- D. Warranty: Manufacturer's standard warranty.

1.4 SUBMITTALS

- A. All submittals under the provisions of Section 01 3300 – Submittal Procedures, unless noted otherwise. Refer to Section 01 3300 – Submittal Procedures, Paragraph 3.1, for descriptions of submittal items. Submittals listed below are required:
- 1. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - a. Trapeze hangers. Include Product Data for components.
 - b. Steel slotted channel systems. Include Product Data for components.
 - c. Equipment supports.
 - 2. Welding certificates.
 - 3. Warranty.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
 - h. Engineer Approved Equal.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 5. Channel Dimensions: Selected for applicable load criteria.

- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 - 5) Engineer Approved Equal.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 - 6) Engineer Approved Equal.
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 - 6. Toggle Bolts: All-steel springhead type.
 - 7. Hanger Rods: Threaded steel.
- G. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Before installation, verify substrate and adjoining work is ready to receive installation of the Work under this Section, per Section 01 4000 – Quality Requirements, Article 3.3 Inspections.

3.2 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.3 SUPPORT INSTALLATION

- A. General: Install according to the manufacturer's written instructions/ recommendations approved during the shop drawing submittal process.
- B. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- C. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- D. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- E. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 - 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.
- F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
 - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Division 09 Painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 POST-INSTALLATION REQUIREMENTS

- A. Clean the Work and affected adjacent materials per the manufacturer's written instructions.
- B. Protect the Work per Section 01 4000 – Quality Requirements, Article 3.5 Protection.
- C. Dispose of and manage construction waste per Section 01 7419 – Construction Waste Management.

END OF SECTION

**SECTION 260533
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 & 01 Specification Sections, apply to this Section. Any Contractor/Supplier who submits a bid, enters into a contract and/or provides work described in this Section acknowledges that they have read and comprehend all Sections within Division 00 & 01 and that this Specification Section.

- B. Work Included:
 - 1. Raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.2 REFERENCES

- A. See Section 01 4200 – References, for all Abbreviations, Acronyms, ANSI & ASTM standards, Specialty Codes and Trade Practices that are referenced herein.

- B. Definitions:
 - 1. See Section 01 4200 – References, for universal definitions related to the Work.
 - 2. EMT: Electrical metallic tubing.
 - 3. ENT: Electrical nonmetallic tubing.
 - 4. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 5. FMC: Flexible metal conduit.
 - 6. IMC: Intermediate metal conduit.
 - 7. LFMC: Liquidtight flexible metal conduit.
 - 8. LFNC: Liquidtight flexible nonmetallic conduit.
 - 9. NBR: Acrylonitrile-butadiene rubber.
 - 10. RNC: Rigid nonmetallic conduit.

- C. Abbreviations and Acronyms
 - 1. ANSI American National Standards Institute
 - 2. ASTM American Society for Testing and Materials
 - 3. NECA National Electrical Contractors Association
 - 4. NEMA National Electrical Manufacturers Association
 - 5. NFPA National Fire Protection Association
 - 6. SCTE Society of Cable Telecommunication Engineers

1.3 QUALITY ASSURANCE

- A. See Section 01 4000 – Quality Requirements, for general quality criteria that the Work shall fulfill.

- B. Work to Conform to:
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 2. Comply with NFPA 70.
 - 3. ANSI standards listed
 - a. ANSI C80.1 – Electrical Rigid Steel Conduit
 - b. ANSI C80.3 – Steel Electrical Metallic Tubing
 - c. ANSI C80.5 – Electrical Rigid Aluminum Conduit
 - d. ANSI C80.6 – Electrical Intermediate Metal Conduit

4. ASTM standards listed
 - a. ASTM A 53/A 53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
5. Trade Practice Sections listed
 - a. NECA 1 – Standard Practices for Good Workmanship in Electrical Construction
 - b. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)
 - c. NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
 - d. NEMA OS 1 – Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
 - e. NEMA OS 2 – Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports
 - f. NEMA RN 1 – Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
 - g. NEMA TC 2 – Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
 - h. NEMA TC 3 – Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
 - i. NEMA TC 13 – Electrical Nonmetallic Tubing
 - j. NFPA 70 – National Electrical Code
 - k. SCTE 77 – Specification for Underground Enclosure Integrity
 - l. UL 514B – Conduit, Tubing, and Cable Fittings
 - m. UL 886 – Standard for Safety Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
 - n. UL 1660 – Liquid-Tight Flexible Nonmetallic Conduit
 - o. UL 2024 – Standard for Cable Routing Assemblies and Communications Raceways

C. Coordination and Pre-Installation Meeting

1. Per Section 01 3100 – Project Management and Coordination.
2. Conduct pre-installation meeting one week before installation.

D. Warranty: Manufacturer's standard warranty.

1.4 SUBMITTALS

- A. All submittals under the provisions of Section 01 3300 – Submittal Procedures, unless noted otherwise. Refer to Section 01 3300 – Submittal Procedures, Paragraph 3.1, for descriptions of submittal items. Submittals listed below are required:
 1. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
 2. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
 - a. Custom enclosures and cabinets.
 - b. For handholes and boxes for underground wiring, including the following:
 - 1) Duct entry provisions, including locations and duct sizes.
 - 2) Frame and cover design.
 - 3) Grounding details.
 - 4) Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
 - 5) Joint details.
 3. Warranty.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
 2. Alflec Inc.
 3. Allied Tube & Conduit; a Tyco International Ltd. Co.
 4. Anamet Electrical, Inc.; Anaconda Metal Hose.
 5. Electri-Flex Co.
 6. Manhattan/CDT/Cole-Flex.
 7. Maverick Tube Corporation.
 8. O-Z Gedney; a unit of General Signal.
 9. Wheatland Tube Company.
 10. Engineer Approved Equal.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Aluminum Rigid Conduit: ANSI C80.5.
- D. IMC: ANSI C80.6.
- E. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
1. Comply with NEMA RN 1.
 2. Coating Thickness: 0.040 inch, minimum.
- F. EMT: ANSI C80.3.
- G. FMC: Aluminum.
- H. LFMC: Flexible steel conduit with PVC jacket.
- I. Fittings for Conduit (Including all Types and Flexible and Liquid tight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 2. Fittings for EMT: Steel or die-cast, set-screw type.
 3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.
- J. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
 3. Arnco Corporation.
 4. CANTEX Inc.
 5. CertainTeed Corp.; Pipe & Plastics Group.
 6. Condux International, Inc.
 7. ElecSYS, Inc.
 8. Electri-Flex Co.
 9. Lamson & Sessions; Carlon Electrical Products.
 10. Manhattan/CDT/Cole-Flex.
 11. RACO; a Hubbell Company.
 12. Thomas & Betts Corporation.
 13. Engineer Approved Equal.
- B. ENT: NEMA TC 13.

- C. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- D. LFNC: UL 1660.
- E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- F. Fittings for LFNC: UL 514B.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Arco Corporation.
 - 2. Endot Industries Inc.
 - 3. IPEX Inc.
 - 4. Lamson & Sessions; Carlon Electrical Products.
 - 5. Engineer Approved Equal.
- B. Description: Comply with UL 2024; flexible type, approved for general-use installation.

2.4 METAL WIREWAYS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
 - 4. Engineer Approved Equal.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type.
- E. Finish: Manufacturer's standard enamel finish.

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - 2. EGS/Appleton Electric.
 - 3. Erickson Electrical Equipment Company.
 - 4. Hoffman.
 - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
 - 6. O-Z/Gedney; a unit of General Signal.
 - 7. RACO; a Hubbell Company.
 - 8. Robroy Industries, Inc.; Enclosure Division.
 - 9. Scott Fetzer Co.; Adalet Division.
 - 10. Spring City Electrical Manufacturing Company.
 - 11. Thomas & Betts Corporation.
 - 12. Walker Systems, Inc.; Wiremold Company (The).
 - 13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
 - 14. Engineer Approved Equal.
- B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

- C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.
- D. Metal Floor Boxes: Cast metal, fully adjustable, rectangular.
- E. Nonmetallic Floor Boxes: Nonadjustable, round.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- H. Cabinets:
 - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. Description: Comply with SCTE 77.
 - 1. Color of Frame and Cover: Green.
 - 2. Configuration: Units shall be designed for flush burial and have integral closed bottom, unless otherwise indicated.
 - 3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
 - 4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - 5. Cover Legend: Molded lettering, as indicated for each service.
 - 6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 - 7. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. CDR Systems Corporation.
 - d. NewBasis.
 - e. Engineer Approved Equal.

2.7 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.

- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.8 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Calpico, Inc.
 - 3. Metraflex Co.
 - 4. Pipeline Seal and Insulator, Inc.
 - 5. Engineer Approved Equal.
- B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
 - 1. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Plastic. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Before installation, verify substrate and adjoining work is ready to receive installation of the Work under this Section, per Section 01 4000 – Quality Requirements, Article 3.3 Inspections.

3.2 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 - 1. Exposed Conduit: Rigid steel conduit or IMC.
 - 2. Concealed Conduit, Aboveground: RNC, Type EPC-40-PVC.
 - 3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
 - a. Within Five Feet from Foundation Wall: Use rigid steel conduit.
 - b. In or Under Slab on Grade: Use thickwall nonmetallic conduit and thinwall nonmetallic conduit.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
 - 6. Application of Handholes and Boxes for Underground Wiring:
 - a. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.
 - b. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Heavy-duty fiberglass units with polymer-concrete frame and cover, SCTE 77, Tier 8 structural load rating.
 - c. Handholes and Pull Boxes Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.
- B. Comply with the following indoor applications, unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.

2. Exposed and Subject to Severe Physical Damage: Rigid steel conduit or IMC. Includes raceways in the following locations:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 5. In Slab Above Grade:
 - a. Use thickwall nonmetallic conduit.
 - b. Maximum Size Conduit in Slab: 3/4 inch.
 6. Damp or Wet Locations: Rigid steel conduit or IMC.
 7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical fiber/communications cable raceway.
 8. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: Plenum-type, optical fiber/communications cable raceway.
 9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits in contact with concrete.

3.3 INSTALLATION

- A. General: Install according to the manufacturer's written instructions/ recommendations approved during the shop drawing submittal process.
- B. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- C. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- D. Complete raceway installation before starting conductor installation.
- E. Support raceways as specified in Section 26 0529 "Hangers and Supports for Electrical Systems."
- F. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- G. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.
- H. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- I. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- L. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- M. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
1. 3/4-Inch Trade Size and Smaller: Install raceways in maximum lengths of 50 feet.
 2. 1-Inch Trade Size and Larger: Install raceways in maximum lengths of 75 feet.
 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- N. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where otherwise required by NFPA 70.
- O. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.
1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.
 3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
- P. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit for recessed or semi-recessed lighting fixtures; equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations.
- Q. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

- R. Set metal floor boxes level and flush with finished floor surface.
- S. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.4 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than 6 inches in nominal diameter.
 - 2. Install backfill as specified in Division 31 Section "Earth Moving."
 - 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
 - 4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose and encase coupling with 3 inches of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
 - 5. Warning Tape: Bury warning tape approximately 12 inches above direct-buried conduits, placing it 24 inches o.c. Route tape along the centerline of conduit.

3.5 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.
- E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.6 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

- D. Rectangular Sleeve Minimum Metal Thickness:
 1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.
- M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.7 SLEEVE-SEAL INSTALLATION

- A. Install to seal underground, exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.8 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.9 POST-INSTALLATION REQUIREMENTS

- A. Clean the Work and affected adjacent materials per the manufacturer's written instructions.

- B. Protect the Work per Section 01 4000 – Quality Requirements, Article 3.5 Protection.
 - 1. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
 - 2. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 3. Repair damage to PVC or paint finishes with matching touch up coating recommended by manufacturer.

- C. Dispose of and manage construction waste per Section 01 7419 – Construction Waste Management.

END OF SECTION

SECTION 260553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 & 01 Specification Sections, apply to this Section. Any Contractor/Supplier who submits a bid, enters into a contract and/or provides work described in this Section acknowledges that they have read and comprehend all Sections within Division 00 & 01 and that this Specification Section.

- B. Work Included:
 - 1. Identification for raceway and metal-clad cable.
 - 2. Identification for conductors and communication and control cable.
 - 3. Underground-line warning tape.
 - 4. Warning labels and signs.
 - 5. Instruction signs.
 - 6. Equipment identification labels.
 - 7. Miscellaneous identification products.

1.2 REFERENCES

- A. See Section 01 4200 – References, for all Abbreviations, Acronyms, ANSI & ASTM standards, Specialty Codes and Trade Practices that are referenced herein.

- B. Abbreviations and Acronyms listed
 - 1. ANSI American National Standards Institute
 - 2. ASTM American Society for Testing and Materials
 - 3. CFR Code of Federal Regulations
 - 4. IEEE Institute of Electrical and Electronics Engineers
 - 5. NEMA National Electrical Manufacturers Association
 - 6. NFPA National Fire Protection Association

1.3 QUALITY ASSURANCE

- A. See Section 01 4000 – Quality Requirements, for general quality criteria of the Work.

- B. Work to Conform to:
 - 1. Comply with ANSI A13.1 and ANSI C2.
 - 2. Comply with NFPA 70.
 - 3. Comply with 29 CFR 1910.145.
 - 4. ANSI standards listed
 - a. ANSI A13.1 – Scheme for the Identification of Piping Systems
 - b. ANSI C2 – National Electrical Safety Code
 - 5. Specialty Code Sections listed
 - a. 29 CFR 1910.145 – Specifications For Accident Prevention Signs And Tags
 - 6. Trade Practice Sections listed
 - a. NFPA 70 – National Electrical Code

- C. Coordination and Pre-Installation Meeting
 - 1. See requirements in Section 01 3100 – Project Management and Coordination.

2. Conduct pre-installation meeting one week before installation.
 - a. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
 - b. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
 - c. Coordinate installation of identifying devices with location of access panels and doors.
 - d. Install identifying devices before installing acoustical ceilings and similar concealment.
3. Warranty: Manufacturer's standard warranty.

1.4 SUBMITTALS

- A. All submittals under the provisions of Section 01 3300 – Submittal Procedures, unless noted otherwise. Refer to Section 01 3300 – Submittal Procedures, Paragraph 3.1, for descriptions of submittal items. Submittals listed below are required:
 1. Product Data: For each electrical identification product indicated.
 2. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.
 3. Warranty.

PART 2 - PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Color for Printed Legend:
 1. Power Circuits: Black letters on an orange field.
 2. Legend: Indicate system or service and voltage, if applicable.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- C. Aluminum Wraparound Marker Labels: Cut from 0.014-inch- thick aluminum sheet, with stamped, embossed, or scribed legend, and fitted with tabs and matching slots for permanently securing around wire or cable jacket or around groups of conductors.

2.3 UNDERGROUND-LINE WARNING TAPE

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
 1. Not less than 6 inches wide by 4 mils thick.
 2. Compounded for permanent direct-burial service.
 3. Embedded continuous metallic strip or core.

4. Printed legend shall indicate type of underground line.

2.4 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.
- D. Warning label and sign shall include, but are not limited to, the following legends:
 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
 3. Arc Flash Hazard Warning: "WARNING – ARC FLASH AND SHOCK HAZARD. APPROPRIATE PPE REQUIRED."

2.5 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16" thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
 1. Engraved legend with black letters on white face.
 2. Punched or drilled for mechanical fasteners.
 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch.
- B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- C. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
 1. Minimum Width: 3/16 inch.
 2. Tensile Strength: 50 lb, minimum.
 3. Temperature Range: Minus 40 to plus 185 deg F.
 4. Color: Black, except where used for color-coding.
- B. Paint: Paint materials and application requirements are specified in Division 09 Painting Sections.
- C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Before installation, verify substrate and adjoining work is ready to receive installation of the Work under this Section, per Section 01 4000 – Quality Requirements, Article 3.3 Inspections.

3.2 APPLICATION

- A. Accessible Raceways and Metal-Clad Cables More Than 600 V: Identify with "DANGER-HIGH VOLTAGE" in black letters at least 2 inches high, with self-adhesive vinyl labels. Repeat legend at 10-foot maximum intervals.
- B. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A: Identify with orange self-adhesive vinyl label or self-adhesive vinyl tape applied in bands.
- C. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:
 - 1. Fire Alarm System: Red.
 - 2. Fire-Suppression Supervisory and Control System: Red and yellow.
 - 3. Combined Fire Alarm and Security System: Red and blue.
 - 4. Security System: Blue and yellow.
 - 5. Mechanical and Electrical Supervisory System: Green and blue.
 - 6. Telecommunication System: Green and yellow.
 - 7. Control Wiring: Green and red.
- D. Power-Circuit Conductor Identification: For primary and secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.
- E. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use aluminum wraparound marker labels. Identify each ungrounded conductor according to source and circuit number.
- F. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source and circuit number.
- G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and Operation and Maintenance Manual.
- H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
 - 1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:

- a. Power transfer switches.
 - b. Controls with external control power connections.
2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.
- J. Instruction Signs:
- 1. Operating Instructions: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
 - 2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer and/or load shedding.
- K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
- 1. Labeling Instructions:
 - a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where 2 lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - 2. Equipment to Be Labeled:
 - a. Panelboards, electrical cabinets, and enclosures.
 - b. Access doors and panels for concealed electrical items.
 - c. Electrical switchgear and switchboards.
 - d. Transformers.
 - e. Electrical substations.
 - f. Emergency system boxes and enclosures.
 - g. Motor-control centers.
 - h. Disconnect switches.
 - i. Enclosed circuit breakers.
 - j. Motor starters.
 - k. Push-button stations.
 - l. Power transfer equipment.
 - m. Contactors.
 - n. Remote-controlled switches, dimmer modules, and control devices.
 - o. Battery inverter units.
 - p. Battery racks.
 - q. Power-generating units.
 - r. Voice and data cable terminal equipment.
 - s. Master clock and program equipment.
 - t. Intercommunication and call system master and staff stations.
 - u. Television/audio components, racks, and controls.
 - v. Fire-alarm control panel and annunciators.
 - w. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
 - x. Monitoring and control equipment.
 - y. Uninterruptible power supply equipment.

- z. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.

3.3 INSTALLATION

- A. General: Install according to the manufacturer's written instructions/ recommendations approved during the shop drawing submittal process.
- B. Verify identity of each item before installing identification products.
- C. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- D. Apply identification devices to surfaces that require finish after completing finish work.
- E. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- F. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- G. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- H. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - 1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- I. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- J. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- K. Painted Identification: Prepare surface and apply paint according to Division 09 Painting Sections.

3.4 POST-INSTALLATION REQUIREMENTS

- A. Clean the Work and affected adjacent materials per the manufacturer's written instructions.

- B. Protect the Work per Section 01 4000 – Quality Requirements, Article 3.5 Protection.
- C. Dispose of and manage construction waste per Section 01 7419 – Construction Waste Management.

END OF SECTION

**SECTION 260923
LIGHTING CONTROL DEVICES**

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 & 01 Specification Sections, apply to this Section. Any Contractor/Supplier who submits a bid, enters into a contract and/or provides work described in this Section acknowledges that they have read and understand all the requirements of Division 00 & 01 and this Section.

- B. Work Included:
 - 1. Time switches.
 - 2. Indoor occupancy sensors.

- C. Related Sections:
 - 1. Section 26 0943 "Network Lighting Controls" for low-voltage, manual and programmable lighting control systems.
 - 2. Section 26 2726 "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.2 REFERENCES

- A. See Section 01 4200 – References, for all Abbreviations, Acronyms, ANSI & ASTM standards, Specialty Codes and Trade Practices that are referenced herein.

- B. Definitions:
 - 1. LED: Light-emitting diode.
 - 2. PIR: Passive infrared.

- C. Abbreviations and Acronyms
 - 1. IEEE Institute of Electrical and Electronics Engineers
 - 2. NECA National Electrical Contractors Association
 - 3. NEMA National Electrical Manufacturers Association
 - 4. NFPA National Fire Protection Association

1.3 QUALITY ASSURANCE

- A. See Section 01 4000 – Quality Requirements, for general quality criteria of the Work.

- B. Work to Conform to:
 - 1. Trade Practice Sections listed
 - a. IEEE C136.10 – Roadway Lighting Equipment - Locking-Type Photocontrol Devices and Mating Receptacle Physical and Electrical Interchangeability and Testing
 - b. NECA 1 – Standard Practices for Good Workmanship in Electrical Construction
 - c. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)
 - d. NEMA ICS 2 – Industrial Control And Systems Controllers, Contactors And Overload Relays Rated 600 Volts
 - e. NFPA 70 – National Electrical Code
 - f. UL 508 – Standard for Industrial Control Equipment
 - g. UL 773A – Standard for Nonindustrial Photoelectric Switches for Lighting Control
 - h. UL 917 – Standard for Clock-Operated Switches

2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Coordination and Pre-Installation Meeting

1. See requirements in Section 01 3100 – Project Management and Coordination.
2. Conduct pre-installation meeting one week before installation.
 - a. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

D. Warranty: Manufacturer's standard warranty.

1.4 SUBMITTALS

- A. All submittals under the provisions of Section 01 3300 – Submittal Procedures, unless noted otherwise. Refer to Section 01 3300 – Submittal Procedures, Paragraph 3.1, for descriptions of submittal items. Submittals listed below are required:
1. Product Data: For each type of product indicated.
 2. Shop Drawings:
 - a. Show installation details for occupancy and light-level sensors.
 - b. Interconnection diagrams showing field-installed wiring.
 3. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.
 4. Warranty.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Lighting Controls
 2. Hubbell Lighting.
 3. Leviton Mfg. Company Inc.
 4. Lithonia Lighting; Acuity Lighting Group, Inc.
 5. Watt Stopper (The).
 6. Engineer Approved Equal.
- B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

- C. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
 - 1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 - 2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.
 - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
 - 4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.
 - 5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot- high ceiling in a corridor not wider than 14 feet.

- D. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
 - 1. Sensitivity Adjustment: Separate for each sensing technology.
 - 2. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

2.2 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSPECTION

- A. Before installation, verify substrate and adjoining work is ready to receive installation of the Work under this Section, per Section 01 4000 – Quality Requirements, Article 3.3 Inspections.

3.2 SENSOR INSTALLATION

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 CONTACTOR INSTALLATION

- A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 26 0553 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify operation of each lighting control device and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 POST-INSTALLATION REQUIREMENTS

- A. Clean the Work and affected adjacent materials per the manufacturer's written instructions.
- B. Protect the Work per Section 01 4000 – Quality Requirements, Article 3.5 Protection.
- C. Dispose of and manage construction waste per Section 01 7419 – Construction Waste Management.
- D. Instruct the Owner's personnel on the proper function and required periodic maintenance.
 - 1. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Section 26 0943 "Network Lighting Controls."
 - 2. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION

SECTION 26 2416 PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 & 01 Specification Sections, apply to this Section. Any Contractor/Supplier who submits a bid, enters into a contract and/or provides work described in this Section acknowledges that they have read and understand all the requirements of Division 00 & 01 and this Section.
- B. Work Included:
 - 1. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Load centers.

1.2 REFERENCES

- A. See Section 01 4200 – References, for all Abbreviations, Acronyms, ANSI & ASTM standards, Specialty Codes and Trade Practices that are referenced herein.
- B. Definitions
 - 1. SVR: Suppressed voltage rating.
 - 2. TVSS: Transient voltage surge suppressor.
- C. Abbreviations and Acronyms
 - 1. ASCE American Society of Civil Engineers
 - 2. IEEE Institute of Electrical and Electronics Engineers
 - 3. NECA National Electrical Contractors Association
 - 4. NEMA National Electrical Manufacturers Association
 - 5. NETA InterNational Electrical Testing Association
 - 6. NFPA National Fire Protection Association
 - 7. SEI Structural Engineering Institute

1.3 QUALITY ASSURANCE

- A. See Section 01 4000 – Quality Requirements, for general quality criteria of the Work.
- B. Work to Conform to:
 - 1. Trade Practice
 - a. IEEE 344 – IEEE Standard for Seismic Qualification of Equipment for Nuclear Power Generating Stations
 - b. IEEE C62.41 – Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits
 - c. NECA 1 – Standard Practices for Good Workmanship in Electrical Construction
 - d. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)
 - e. NEMA FU 1 – Low Voltage Cartridge Fuses
 - f. NEMA PB 1 – Panelboards
 - g. NEMA PB 1.1 – General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 V or Less
 - h. NFPA 70 – National Electrical Code
 - i. SEI/ASCE 7 – Minimum Design Loads for Buildings and Other Structures
 - j. UL 67 – Standard for Panelboards

- k. UL 489 – Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
 - l. UL 1449 – Standard for Surge Protective Devices
 - m. UL 1699 – Arc-Fault Circuit-Interrupters
 - n. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - o. Comply with NEMA PB 1.
2. Comply with NFPA 70.
 3. Seismic Performance: Seismic tested and qualified in accordance with the 2018 International Building Code (IBC).
 4. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
 5. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Testing Agency Qualifications: Member company of NETA or an NRTL.
- D. Project Conditions/ Environmental Controls
1. Remove loose packing and flammable materials from inside panelboards.
 2. Handle and prepare panelboards for installation according to NEMA PB 1.
 - a. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 3. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
 4. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - a. Notify Prime Contractor no fewer than seven days in advance of proposed interruption of electric service.
 - b. Do not proceed with interruption of electric service without Prime Contractor's written permission.
 - c. Comply with NFPA 70E.
- E. Coordination and Pre-Installation Meeting
1. See requirements in Section 01 3100 – Project Management and Coordination.
 2. Conduct pre-installation meeting one week before installation.
 - a. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- F. Warranty: Manufacturer's standard warranty.

1.5 SUBMITTALS

- A. All submittals under the provisions of Section 01 3300 – Submittal Procedures, unless noted otherwise. Refer to Section 01 3300 – Submittal Procedures, Paragraph 3.1, for descriptions of submittal items. Submittals listed below are required:
1. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 2. Shop Drawings: For each panelboard and related equipment.
 - a. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - b. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - c. Detail bus configuration, current, and voltage ratings.
 - d. Short-circuit current rating of panelboards and overcurrent protective devices.
 - e. Include evidence of NRTL listing for series rating of installed devices.
 - f. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - g. Include wiring diagrams for power, signal, and control wiring.
 3. Qualification Data: For qualified testing agency.
 4. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems." Include the following:
 - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 5. Field Quality-Control Reports:
 - a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
 6. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
 7. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - a. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - b. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.
 8. Warranty
- B. Extra Stock
1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 2. Keys: Two spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces.
- B. Enclosures: Flush- and surface-mounted cabinets, as indicated on Drawings.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
 - 3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
 - 4. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 - 5. Finishes:
 - a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized coated material.
 - 6. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- C. Incoming Mains Location: Top and bottom, as indicated on Drawings.
- D. Phase, Neutral, and Ground Buses:
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
 - 3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Hard-drawn copper, 98 percent conductivity.
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 - 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 - 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.

2. Square D; a brand of Schneider Electric.
 3. Siemens Energy & Automation, Inc.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: Circuit breaker or Lugs only, as indicated on Drawings.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.
 2. Square D; a brand of Schneider Electric.
 3. Siemens Energy & Automation, Inc.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker or lugs only, as indicated on Drawings.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.
 2. Square D; a brand of Schneider Electric.
 3. Siemens Energy & Automation, Inc.
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replaceable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

5. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
7. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

PART 3 - PRODUCTS

3.1 INSPECTION

- A. Before installation, verify substrate and adjoining work is ready to receive installation of the Work under this Section, per Section 01 4000 – Quality Requirements, Article 3.3 Inspections.
- B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install according to the manufacturer's written instructions/ recommendations approved during the shop drawing submittal process.
- B. Install panelboards and accessories according to NEMA PB 1.1.
- C. Comply with mounting and anchoring requirements.
- D. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- E. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- F. Install overcurrent protective devices and controllers not already factory installed.
 1. Set field-adjustable, circuit-breaker trip ranges.
- G. Install filler plates in unused spaces.
- H. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- I. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- J. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 26 0553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- C. Panelboards will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 - 1. Measure as directed during period of normal system loading.

2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 POST-INSTALLATION REQUIREMENTS

- A. Clean the Work and affected adjacent materials per the manufacturer's written instructions.
- B. Protect the Work per Section 01 4000 – Quality Requirements, Article 3.5 Protection.
- C. Dispose of and manage construction waste per Section 01 7419 – Construction Waste Management.
- D. Instruct the Owner's personnel on the proper function and required periodic maintenance.

END OF SECTION

SECTION 26 2726 WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 & 01 Specification Sections, apply to this Section. Any Contractor/Supplier who submits a bid, enters into a contract and/or provides work described in this Section acknowledges that they have read and understand all the requirements of Division 00 & 01 and this Section.

- B. Work Included:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Twist-locking receptacles.
 - 3. Wall-box motion sensors.
 - 4. Isolated-ground receptacles.
 - 5. Snap switches.
 - 6. Wall-switch and exterior occupancy sensors.
 - 7. Communications outlets.
 - 8. Pendant cord-connector devices.
 - 9. Cord and plug sets.
 - 10. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.

1.2 REFERENCES

- A. See Section 01 4200 – References, for all Abbreviations, Acronyms, ANSI & ASTM standards, Specialty Codes and Trade Practices that are referenced herein.

- B. Definitions listed
 - 1. EMI: Electromagnetic interference.
 - 2. GFCI: Ground-fault circuit interrupter.
 - 3. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
 - 4. RFI: Radio-frequency interference.
 - 5. SPD: Surge protection device.
 - 6. UTP: Unshielded twisted pair.

- C. Abbreviations and Acronyms listed
 - 1. IEEE Institute of Electrical and Electronics Engineers
 - 2. NECA National Electrical Contractors Association
 - 3. NEMA National Electrical Manufacturers Association
 - 4. NFPA National Fire Protection Association

1.3 QUALITY ASSURANCE

- A. See Section 01 4000 – Quality Requirements, for general quality criteria of the Work.

- B. Work to Conform to:
 - 1. Trade Practice Sections listed:
 - a. IEEE C62.41.2 – Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits
 - b. IEEE C62.45 – Recommended Practice on Surge Testing for Equipment Connected to Low-Voltage (1000 V and less) AC Power Circuits
 - c. NECA 1 – Standard Practices for Good Workmanship in Electrical Construction
 - d. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)

- e. NEMA WD 1 – General Color Requirements For Wiring Devices
 - f. NEMA WD 6 – Wiring Devices - Dimensional Specifications
 - g. NFPA 70 – National Electrical Code
 - h. NFPA 99 – Health Care Facilities Code
 - i. UL 20 – General-Use Snap Switches
 - j. UL 498 – Standard for Attachment Plugs and Receptacles
 - k. UL 943 – Ground-Fault Circuit-Interrupters
 - l. UL 1436 – Standard for Outlet Circuit Testers and Similar Indicating Devices
 - m. UL 1472 – Solid-State Dimming Controls
 - n. UL 1449 – Standard for Surge Protective Devices
- 2. UL 1917 – Standard for Solid-State Fan Speed Controls.
 - 3. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
 - 4. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 5. Comply with NFPA 70.
 - 6. Receptacles for Owner-Furnished Equipment: Match plug configurations.
 - 7. Cord and Plug Sets: Match equipment requirements.
- C. Coordination and Pre-Installation Meeting
- 1. See requirements in Section 01 3100 – Project Management and Coordination.
 - 2. Conduct pre-installation meeting one week before installation.
- D. Warranty: Manufacturer's standard warranty.

1.4 SUBMITTALS

- A. All submittals under the provisions of Section 01 3300 – Submittal Procedures, unless noted otherwise. Refer to Section 01 3300 – Submittal Procedures, Paragraph 3.1, for descriptions of submittal items. Submittals listed below are required:
- 1. Product Data: For each type of product indicated.
 - 2. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
 - 3. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.
 - 4. Warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
- 1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
 - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
 - 3. Leviton Mfg. Company Inc. (Leviton).
 - 4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).
 - 5. Engineer Approved Equal.

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

- B. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
- C. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A.

2.4 TWIST-LOCKING RECEPTACLES

- A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.
- B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.5 PENDANT CORD-CONNECTOR DEVICES

- A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.
 - 1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
 - 2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.6 CORD AND PLUG SETS

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
 - 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.7 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A.
- C. Pilot Light Switches, 20 A: Single pole, with neon-lighted handle, illuminated when switch is "ON."
- D. Key-Operated Switches, 120/277 V, 20 A: Single pole, with factory-supplied tumbler-style key in lieu of switch handle.

2.8 OCCUPANCY SENSORS

- A. Wall-Switch Sensors: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft..

2.9 WALL PLATES

- A. Single and combination types to match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: 0.035-inch- thick, satin-finished stainless steel.
 - 3. Material for Unfinished Spaces: Galvanized steel.
 - 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable "in-use" cover.

2.10 FLOOR SERVICE FITTINGS

- A. Type: Modular, flap-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Rectangular, solid brass with satin finish.
- D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 Category 6 jacks for UTP cable.

2.11 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.
 - 1. Service Outlet Assembly: Flush type with two simplex receptacles.
 - 2. Size: Selected to fit nominal 3-inch cored holes in floor and matched to floor thickness.
 - 3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
 - 4. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors.

2.12 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: Gray, unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to Emergency Power System: Red.
 - 3. SPD Receptacles: Blue.
 - 4. Isolated-Ground Receptacles: Orange.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Before installation, verify substrate and adjoining work is ready to receive installation of the Work under this Section, per Section 01 4000 – Quality Requirements, Article 3.3 Inspections.

3.2 INSTALLATION

- A. General: Install according to the manufacturer's written instructions/ recommendations approved during the shop drawing submittal process.
- B. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- C. Coordination with Other Trades:
 - 1. Take steps to ensure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- D. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailing existing conductors is permitted provided the outlet box is large enough.
- E. Device Installation:
 - 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
 - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
 - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
 - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
 - 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
 - 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
 - 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
 - 8. Tighten unused terminal screws on the device.
 - 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
- F. Receptacle Orientation:
 - 1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.
- G. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- I. Adjust locations of floor service outlets to suit arrangement of partitions and furnishings.

3.3 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."
 - 1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Test Instruments: Use instruments that comply with UL 1436.
 - 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

3.5 POST-INSTALLATION REQUIREMENTS

- A. Clean the Work and affected adjacent materials per the manufacturer's written instructions.
- B. Protect the Work per Section 01 4000 – Quality Requirements, Article 3.5 Protection.
- C. Dispose of and manage construction waste per Section 01 7419 – Construction Waste Management.
- D. Instruct the Owner's personnel on the proper function and required periodic maintenance.

END OF SECTION

SECTION 26 2816
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 & 01 Specification Sections, apply to this Section. Any Contractor/Supplier who submits a bid, enters into a contract and/or provides work described in this Section acknowledges that they have read and understand all the requirements of Division 00 & 01 and this Section.

- B. Work Included:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Molded-case circuit breakers (MCCBs).
 - 4. Enclosures.

1.2 REFERENCES

- A. See Section 01 4200 – References, for all Abbreviations, Acronyms, ANSI & ASTM standards, Specialty Codes and Trade Practices that are referenced herein.

- B. Definitions:
 - 1. See Section 01 4200 – References, for universal definitions related to the Work.
 - 2. NC: Normally closed.
 - 3. NO: Normally open.
 - 4. SPDT: Single pole, double throw.
 - 5. Withstand: The unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event.

1.3 QUALITY ASSURANCE

- A. See Section 01 4000 – Quality Requirements, for general quality criteria of the Work.

- B. Work to Conform to:
 - 1. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - a. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
 - 2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 3. Comply with NFPA 70.
 - 4. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

- C. Project Conditions/ Environmental Controls
 - 1. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
 - 2. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

3. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
 4. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - a. Notify Prime Contractor no fewer than seven days in advance of proposed interruption of electric service.
 - b. Indicate method of providing temporary electric service.
 - c. Do not proceed with interruption of electric service without Prime Contractor's written permission.
 - d. Comply with NFPA 70E.
- D. Coordination and Pre-Installation Meeting
1. See requirements in Section 01 3100 – Project Management and Coordination.
 2. Conduct pre-installation meeting one week before installation.
 - a. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels
- E. Warranty: Manufacturer's standard warranty.

1.4 SUBMITTALS

- A. All submittals under the provisions of Section 01 3300 – Submittal Procedures, unless noted otherwise. Refer to Section 01 3300 – Submittal Procedures, Paragraph 3.1, for descriptions of submittal items. Submittals listed below are required:
1. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Current and voltage ratings.
 - c. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - d. Include evidence of NRTL listing for series rating of installed devices.
 - e. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - f. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
 2. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 - a. Wiring Diagrams: For power, signal, and control wiring.
 3. Qualification Data: For qualified testing agency.
 4. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.
 - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

5. Field quality-control reports.
 - a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
 6. Manufacturer's field service report.
 7. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
 8. Warranty.
- B. Extra Stock.
1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 2. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 3. Fuse Pullers: Two for each size and type

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. Square D; a brand of Schneider Electric.
 3. Siemens Energy & Automation, Inc.
- B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 5. Hookstick Handle: Allows use of a hookstick to operate the handle.
 6. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.2 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. Square D; a brand of Schneider Electric.
 3. Siemens Energy & Automation, Inc.

- B. Type HD, Heavy Duty, Six Pole, Single Throw, 600-V ac, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
 - 4. Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 - 2. Square D; a brand of Schneider Electric.
 - 3. Siemens Energy & Automation, Inc.
- B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 - 1. Instantaneous trip.
 - 2. Long- and short-time pickup levels.
 - 3. Long- and short-time time adjustments.
 - 4. Ground-fault pickup level, time delay, and I^2t response.
- F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- G. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- H. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

2.4 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 3R.
 3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Before installation, verify substrate and adjoining work is ready to receive installation of the Work under this Section, per Section 01 4000 – Quality Requirements, Article 3.3 Inspections.
- B. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install according to the manufacturer's written instructions/ recommendations approved during the shop drawing submittal process.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in fusible devices.
- F. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."
 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
 2. Test continuity of each circuit.
- D. Tests and Inspections:
1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges.

3.6 POST-INSTALLATION REQUIREMENTS

- A. Clean the Work and affected adjacent materials per the manufacturer's written instructions.
- B. Protect the Work per Section 01 4000 – Quality Requirements, Article 3.5 Protection.
- C. Dispose of and manage construction waste per Section 01 7419 – Construction Waste Management.
- D. Instruct the Owner's personnel on the proper function and required periodic maintenance.

END OF SECTION

**SECTION 26 5119
LED LIGHTING**

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 & 01 Specification Sections, apply to this Section. Any Contractor/Supplier who submits a bid, enters into a contract and/or provides work described in this Section acknowledges that they have read and understand all the requirements of Division 00 & 01 and this Section.

- B. Work Included:
 - 1. Solid-state luminaires that use LED technology.
 - 2. Lighting fixture supports.

- C. Related Requirements:
 - 1. Section 26 0923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
 - 2. Section 26 2416 "Panelboards" for panelboards used for lighting control.

1.2 REFERENCES

- A. See Section 01 4200 – References, for all Abbreviations, Acronyms, ANSI & ASTM standards, Specialty Codes and Trade Practices that are referenced herein.

- B. Definitions:
 - 1. See Section 01 4200 – References, for universal definitions related to the Work.
 - 2. CCT: Correlated color temperature.
 - 3. CRI: Color Rendering Index.
 - 4. Fixture: See "Luminaire."
 - 5. IP: International Protection or Ingress Protection Rating.
 - 6. LED: Light-emitting diode.
 - 7. Lumen: Measured output of lamp and luminaire, or both.
 - 8. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 QUALITY ASSURANCE

- A. See Section 01 4000 – Quality Requirements, for general quality criteria of the Work.

- B. Work to Conform to:
 - 1. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
 - 2. Provide luminaires from a single manufacturer for each luminaire type.
 - 3. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

- C. Project Conditions/ Environmental Controls:
 - 1. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

- D. Coordination and Pre-Installation Meeting
 - 1. See requirements in Section 01 3100 – Project Management and Coordination.

2. Conduct pre-installation meeting one week before installation.

E. Warranty

1. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
2. Warranty Period: Five year(s) from date of Substantial Completion.

1.4 SUBMITTALS

- A. All submittals under the provisions of Section 01 3300 – Submittal Procedures, unless noted otherwise. Refer to Section 01 3300 – Submittal Procedures, Paragraph 3.1, for descriptions of submittal items.

- B. Submittals listed below are required:

1. Product Data: For each type of product.
 - a. Arrange in order of luminaire designation.
 - b. Include data on features, accessories, and finishes.
 - c. Include physical description and dimensions of luminaires.
 - d. Include emergency lighting units, including batteries and chargers.
 - e. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
 - f. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated for the lighting fixture as applied in this Project IES LM-79 and IES LM-80.
 - 1) Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - 2) Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
2. Shop Drawings: For nonstandard or custom luminaires.
 - a. Include plans, elevations, sections, and mounting and attachment details.
 - b. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - c. Include diagrams for power, signal, and control wiring.
 - d. Include Samples of luminaires and accessories to verify finish selection.
3. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.
4. Qualification Data: For testing laboratory providing photometric data for luminaires.
5. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 - a. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.
6. Warranty

- C. Extra Stock:

1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - a. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - b. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. Recessed Fixtures: Comply with NEMA LE 4.
- E. Bulb shape complying with ANSI C79.1.
- F. Lamp base complying with or IEC 60061-1.
- G. CRI of 80. CCT of 3500 K.
- H. Rated lamp life of 50,000 hours.
- I. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- J. Internal driver.
- K. Nominal Operating Voltage: 120 V ac or 277 V ac as indicated on Drawings.
 - 1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

2.2 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Diffusers and Globes:
 - 1. Prismatic glass
 - 2. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 3. Glass: Annealed crystal glass unless otherwise indicated.
 - 4. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- D. Housings:
 - 1. Extruded-aluminum housing and heat sink.
 - 2. Clear anodized finish.
- E. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI for all luminaires.

2.3 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE FIXTURE SUPPORT COMPONENTS

- A. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Before installation, verify substrate and adjoining work is ready to receive installation of the Work under this Section, per Section 01 4000 – Quality Requirements, Article 3.3 Inspections.
- B. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- C. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. General: Install according to the manufacturer's written instructions/ recommendations approved during the shop drawing submittal process.
- B. Comply with NECA 1.
- C. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- D. Install lamps in each luminaire.

E. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

F. Flush-Mounted Luminaire Support:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

G. Wall-Mounted Luminaire Support:

1. Attached to structural members in walls.
2. Do not attach luminaires directly to gypsum board.

H. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with two 5/32-inch-diameter aircraft cable supports adjustable to 120 inches in length.

I. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

J. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of two locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of two locations, spaced near corners of luminaire.

K. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Coordinate "Operational Test" Subparagraph below with requirements in Section 26 0923 "Lighting Control Devices."
2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

- B. Luminaire will be considered defective if it does not pass operation tests and inspections.

- C. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

3.7 POST-INSTALLATION REQUIREMENTS

- A. Clean the Work and affected adjacent materials per the manufacturer's written instructions.
- B. Protect the Work per Section 01 4000 – Quality Requirements, Article 3.5 Protection.
- C. Dispose of and manage construction waste per Section 01 7419 – Construction Waste Management.
- D. Instruct the Owner's personnel on the proper function and required periodic maintenance.

END OF SECTION

**SECTION 270500
COMMON WORK RESULTS FOR COMMUNICATIONS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 & 01 Specification Sections, apply to this Section. Any Contractor/Supplier who submits a bid, enters into a contract and/or provides work described in this Section acknowledges that they have read and understand all the requirements of Division 00 & 01 and this Section.
- B. Work Includes:
 - 1. Communications equipment coordination and installation.
 - 2. Common communications installation requirements.

1.2 REFERENCES

- A. See Section 01 4200 – References, for all Abbreviations, Acronyms, ANSI & ASTM standards, Specialty Codes and Trade Practices that are referenced herein.
- B. Definitions:
 - 1. See Section 01 4200 – References, for universal definitions related to the Work
 - a. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - b. NBR: Acrylonitrile-butadiene rubber.
- C. Abbreviations and Acronyms listed
 - 1. ASTM American Society for Testing and Materials
 - 2. NECA National Electrical Contractors Association

1.3 QUALITY ASSURANCE

- A. See Section 01 4000 – Quality Requirements, for general quality criteria of the Work.
- B. Work to Conform to:
 - 1. ASTM Standards listed
 - a. ASTM A 53/A 53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - b. ASTM C 1107 Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
 - 2. Trade Practice Sections listed
 - a. NECA 1 Standard Practices for Good Workmanship in Electrical Construction
- C. Coordination and Pre-Installation Meeting
 - 1. See requirements in Section 01 3100 – Project Management and Coordination.
 - 2. Conduct pre-installation meeting one week before installation.
 - a. Coordinate arrangement, mounting, and support of communications equipment:
 - 1) To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2) To provide for ease of disconnecting the equipment with minimum interference to other installations.

- 3) To allow right of way for piping and conduit installed at required slope.
- 4) So connecting pathways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

D. Warranty: Manufacturer's standard warranty.

1.4 SUBMITTALS

- A. All submittals under the provisions of Section 01 3300 – Submittal Procedures, unless noted otherwise. Refer to Section 01 3300 – Submittal Procedures, Paragraph 3.1, for descriptions of submittal items. Submittals listed below are required:
1. Product Data: For sleeve seals.
 2. Warranty.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 INSPECTION

- A. Before installation, verify substrate and adjoining work is ready to receive installation of the Work under this Section, per Section 01 4000 – Quality Requirements, Article 3.3 Inspections.

3.2 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications' equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.3 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.4 POST-INSTALLATION REQUIREMENTS

- A. Clean the Work and affected adjacent materials per the manufacturer's written instructions.
- B. Protect the Work per Section 01 4000 – Quality Requirements, Article 3.5 Protection.
- C. Dispose of and manage construction waste per Section 01 7419 – Construction Waste Management.

D. Instruct the Owner's personnel on the proper function and required periodic maintenance.

END OF SECTION

**SECTION 27 1100
COMMUNICATIONS EQUIPMENT ROOM FITTINGS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 & 01 Specification Sections, apply to this Section. Any Contractor/Supplier who submits a bid, enters into a contract and/or provides work described in this Section acknowledges that they have read and understand all the requirements of Division 00 & 01 and this Section.

- B. Work Included:
 - 1. Telecommunications mounting elements.
 - 2. Backboards.
 - 3. Telecommunications equipment racks and cabinets.
 - 4. Telecommunications service entrance pathways.
 - 5. Grounding.

- C. Related Sections:
 - 1. Section 27 1500 "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.
 - 2. Section 28 0513 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.2 REFERENCES

- A. See Section 01 4200 – References, for all Abbreviations, Acronyms, ANSI & ASTM standards, Specialty Codes and Trade Practices that are referenced herein.

- B. Definitions
 - 1. See Section 01 4200 – References, for universal definitions related to the Work.
 - 2. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
 - 3. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel not exceeding 6 inches in width.
 - 4. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
 - 5. LAN: Local area network.
 - 6. RCDD: Registered Communications Distribution Designer.
 - 7. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of a bottom without ventilation openings within integral or separate longitudinal side rails.
 - 8. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.
 - 9. Withstand: The unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event.

- C. Abbreviations and Acronyms
 - 1. ANSI American National Standards Institute
 - 2. ASCE American Society of Civil Engineers
 - 3. ASTM American Society for Testing and Materials
 - 4. BICSI Building Industry Consulting Service International, Inc.
 - 5. EIA Electronic Industries Alliance
 - 6. NECA National Electrical Contractors Association

- 7. NEMA National Electrical Manufacturers Association
- 8. NFPA National Fire Protection Association
- 9. SEI Structural Engineering Institute
- 10. TIA Telecommunications Industry Association

1.3 QUALITY ASSURANCE

- A. See Section 01 4000 – Quality Requirements, for general quality criteria of the Work.
- B. Work to Conform to:
 - 1. NSI Standards
 - a. ANSI-J-STD-607-A – Commercial Building Grounding (Earthing) and Bonding Requirements For Telecommunications
 - 2. ASTM Standards
 - a. ASTM A123/A123M – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - b. ASTM B633 Standard – Specification for Electrodeposited Coatings of Zinc on Iron and Steel
 - 3. Trade Practice
 - a. EIA 310 – Cabinets, Racks, Panels, And Associated Equipment
 - b. NECA 1 – Standard Practices for Good Workmanship in Electrical Construction
 - c. NEMA WD 6 – Wiring Devices - Dimensional Specifications
 - d. NEMA VE 2 – Cable Tray Installation Guidelines
 - e. NFPA 70 – National Electrical Code
 - f. SEI/ASCE 7 – Minimum Design Loads for Buildings and Other Structures
 - g. TIA/EIA-569-A – Commercial Building Standard for Telecommunications Pathways and Spaces
 - h. TIA/EIA-606-A – Administration Standard for Commercial Telecommunications Infrastructure
 - i. UL 891 – Switchboards
 - j. UL 969 – Standard for Marking and Labeling Systems
 - k. UL 1363 – Standard for Relocatable Power Taps
 - l. UL 1449 – Standard for Surge Protective Devices
 - m. UL 2043 – Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces
 - 4. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 5. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
 - 6. Grounding: Comply with ANSI-J-STD-607-A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 - 7. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.
 - 8. Installation Qualifications: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
 - 9. Field Inspector Qualifications: Currently registered by BICSI as Commercial Installer, Level 2 to perform the on-site inspection.
- C. Project Conditions/ Environmental Controls:
 - 1. Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.
- D. Coordination and Pre-Installation Meeting
 - 1. See requirements in Section 01 3100 – Project Management and Coordination.

2. Conduct pre-installation meeting one week before installation.
 - a. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
 - 1) Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
 - 2) Record agreements reached in meetings and distribute them to other participants.
 - 3) Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
 - 4) Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.
 - b. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.
- E. Warranty: Manufacturer's standard warranty.

1.4 SUBMITTALS

- A. All submittals under the provisions of Section 01 3300 – Submittal Procedures, unless noted otherwise. Refer to Section 01 3300 – Submittal Procedures, Paragraph 3.1, for descriptions of submittal items. Submittals listed below are required:
 1. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
 2. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.
 - a. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - b. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.
 - c. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.
 3. Warranty.
- B. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.
 1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
 2. Support brackets with cable tie slots for fastening cable ties to brackets.
 3. Lacing bars, spools, J-hooks, and D-rings.

4. Straps and other devices.
- C. Cable Trays:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cable Management Solutions, Inc.
 - b. Cablofil Inc.
 - c. Cooper B-Line, Inc.
 - d. Cope - Tyco/Allied Tube & Conduit.
 - e. GS Metals Corp.
 - f. Engineer Approved Equal.
- D. Cable Tray Materials: Metal, suitable for indoors and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch thick.
1. Basket Cable Trays: 12 inches wide and 4 inches deep. Wire mesh spacing shall not exceed 2 by 4 inches.
 2. Ladder Cable Trays: Nominally 18 inches wide, and a rung spacing of 12 inches.
- E. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels specified in Division 06 Section "Rough Carpentry."

2.3 EQUIPMENT FRAMES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Panduit Corp.
 2. Hoffman
 3. Hubbell Premise Wiring.
 4. Leviton Voice & Data Division.
 5. Engineer Approved Equal.
- B. General Frame Requirements:
1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
 2. Module Dimension: Width compatible with EIA 310 standard, 19-inch panel mounting.
 3. Finish: Manufacturer's standard, baked-polyester powder coat.
- C. Floor-Mounted Racks: Modular-type, aluminum construction.
1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.
 2. Baked-polyester powder coat finish.
- D. Cable Management for Equipment Frames:
1. Metal, with integral wire retaining fingers.
 2. Baked-polyester powder coat finish.
 3. Vertical cable management panels shall have front and rear channels, with covers.
 4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.4 POWER STRIPS

- A. Power Strips: Comply with UL 1363.
 - 1. Rack mounting.
 - 2. Six, 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
 - 3. LED indicator lights for power and protection status.
 - 4. LED indicator lights for reverse polarity and open outlet ground.
 - 5. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
 - 6. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
 - 7. Cord connected with 15-foot line cord.
 - 8. Rocker-type on-off switch, illuminated when in on position.
 - 9. Peak Single-Impulse Surge Current Rating: 26 13 kA per phase.
 - 10. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all 3 modes shall be not more than 330 V.

2.5 GROUNDING

- A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.
- B. Telecommunications Main Bus Bar:
 - 1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
 - 2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide with 9/32-inch holes spaced 1-1/8 inches apart.
 - 3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.
- C. Comply with ANSI-J-STD-607-A.

2.6 LABELING

- A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Before installation, verify substrate and adjoining work is ready to receive installation of the Work under this Section, per Section 01 4000 – Quality Requirements, Article 3.3 Inspections.

3.2 ENTRANCE FACILITIES

- A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

3.3 INSTALLATION

- A. General: Install according to the manufacturer's written instructions/ recommendations approved during the shop drawing submittal process.
- B. Comply with NECA 1.
- C. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

- D. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- E. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.4 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping." "Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
 - 1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Division 26 Section "Identification for Electrical Systems." Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- B. Labels shall be preprinted or computer-printed type.

3.7 POST-INSTALLATION REQUIREMENTS

- A. Clean the Work and affected adjacent materials per the manufacturer's written instructions.
- B. Protect the Work per Section 01 4000 – Quality Requirements, Article 3.5 Protection.
- C. Dispose of and manage construction waste per Section 01 7419 – Construction Waste Management.
- D. Instruct the Owner's personnel on the proper function and required periodic maintenance.

END OF SECTION

**SECTION 271500
COMMUNICATIONS HORIZONTAL CABLING**

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 & 01 Specification Sections, apply to this Section. Any Contractor/Supplier who submits a bid, enters into a contract and/or provides work described in this Section acknowledges that they have read and understand all the requirements of Division 00 & 01 and this Section.
- B. Description:
 - 1. Horizontal cable and its connecting hardware as a means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room.
- C. Work Included:
 - 1. Pathways.
 - 2. UTP cabling.
 - 3. 50/125-micrometer, optical fiber cabling.
 - 4. Cable connecting hardware, patch panels, and cross-connects.
 - 5. Telecommunications outlet/connectors.
 - 6. Cabling system identification products.
- D. Related Sections:
 - 1. Section 28 0513 "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.2 REFERENCES

- A. See Section 01 4200 – References, for all Abbreviations, Acronyms, ANSI & ASTM standards, Specialty Codes and Trade Practices that are referenced herein.
- B. Definitions
 - 1. See Section 01 4200 – References, for universal definitions related to the Work
 - 2. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
 - 3. BICSI: Building Industry Consulting Service International.
 - 4. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel.
 - 5. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
 - 6. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
 - 7. EMI: Electromagnetic interference.
 - 8. IDC: Insulation displacement connector.
 - 9. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
 - 10. LAN: Local area network.
 - 11. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
 - 12. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
 - 13. Permanent Link: Horizontal cabling and its connecting hardware.
 - 14. RCDD: Registered Communications Distribution Designer.

15. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom without ventilation openings.
16. Trough or Ventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom having openings for the passage of air.
17. UTP: Unshielded twisted pair.

1.3 QUALITY ASSURANCE

- A. See Section 01 4000 – Quality Requirements, for general quality criteria of the Work.
- B. Work to Conform to:
 1. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1, when tested according to test procedures of this standard.
 2. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 3. Flame-Spread Index: 25 or less.
 4. Smoke-Developed Index: 50 or less.
 5. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
 6. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
 7. Bridged taps and splices shall not be installed in the horizontal cabling.
 8. Splitters shall not be installed as part of the optical fiber cabling.
 9. A work area is approximately 100 sq. ft., and includes the components that extend from the telecommunications outlet/connectors to the station equipment.
 10. The maximum allowable horizontal cable length is 295 feet.
 - a. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment.
 - b. The maximum allowable length does not include an allowance for the length of 16 feet in the horizontal cross-connect.
 11. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 12. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.
 13. Grounding: Comply with ANSI-J-STD-607-A.
- C. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
 1. Layout Qualifications: Preparation of Shop Drawings by an RCDD.
 2. Installation Qualifications: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
 3. Testing Supervisor Qualifications: Currently certified by BICSI as an RCDD to supervise on-site testing.
- D. Testing Agency Qualifications: An NRTL.
 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- E. Project Conditions/ Environmental Controls
 1. Test cables upon receipt at Project site.
 - a. Test optical fiber cables to determine the continuity of the strand end to end. Use optical fiber flashlight.
 - b. Test each pair of UTP cable for open and short circuits.

2. Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

F. Coordination and Pre-Installation Meeting

1. See requirements in Section 01 3100 – Project Management and Coordination.
2. Conduct pre-installation meeting one week before installation.
 - a. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.
 - b. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

G. Warranty: Manufacturer's standard warranty.

1.4 SUBMITTALS

- A. All submittals under the provisions of Section 01 3300 – Submittal Procedures, unless noted otherwise. Refer to Section 01 3300 – Submittal Procedures, Paragraph 3.1, for descriptions of submittal items. Submittals listed below are required:
1. Product Data: For each type of product indicated.
 - a. For coaxial cable, include the following installation data for each type used:
 - 1) Nominal OD.
 - 2) Minimum bending radius.
 - 3) Maximum pulling tension.
 2. Shop Drawings:
 - a. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
 - b. System Labeling Schedules: Electronic copy of labeling schedules that are part of the cabling and asset identification system of the software.
 - c. Cabling administration drawings and printouts.
 - d. Wiring diagrams to show typical wiring schematics, including the following:
 - 1) Cross-connects.
 - 2) Patch panels.
 - 3) Patch cords.
 - e. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.
 - f. Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
 - 1) Vertical and horizontal offsets and transitions.
 - 2) Clearances for access above and to side of cable trays.
 - 3) Vertical elevation of cable trays above the floor or bottom of ceiling structure.
 - 4) Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
 3. Source quality-control reports.
 4. Field quality-control reports.
 5. Maintenance Data: For splices and connectors to include in maintenance manuals.
 6. Software and Firmware Operational Documentation:
 - a. Software operating and upgrade manuals.
 - b. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - c. Device address list.
 - d. Printout of software application and graphic screens.

7. Warranty
- B. Extra Stock
1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - a. Patch-Panel Units: One of each type.
 - b. Connecting Blocks: One of each type.
 - c. Device Plates: One of each type.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. General Requirements: Comply with TIA/EIA-569-A.
- B. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
1. Support brackets with cable tie slots for fastening cable ties to brackets.
 2. Lacing bars, spools, J-hooks, and D-rings.
 3. Straps and other devices.
- C. Cable Trays:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. B-line, an Eaton business.
 - b. Cooper Industries; Cooper B-Line; GS Metals Corp.
 - c. Hubbell Incorporated; Wiring Device-Kellems.
 - d. Legrand US.
 - e. Snaketray
 - f. Engineer Approved Equal.
 2. Cable Tray Materials: Metal, suitable for indoors, and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch thick.
 - a. Basket Cable Trays: 12 inches wide and 4 inches deep. Wire mesh spacing shall not exceed 2 by 4 inches.

2.2 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Belden CDT Inc.; Electronics Division.
 2. Berk-Tek; a Nexans company.
 3. CommScope, Inc.
 4. General Cable
 5. Mohawk; a division of Belden CDT.
 6. Superior Essex Inc.
 7. Engineer Approved Equal.
- B. Description: 100-ohm, 4-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.
1. Comply with ICEA S-90-661 for mechanical properties.
 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 3. Comply with TIA/EIA-568-B.2, Category 6.
 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

- a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
- b. Communications, Riser Rated: Type CMR, complying with UL 1666.
- c. Communications, Limited Purpose: Type CMX.
- d. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
- e. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.3 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Leviton eXtreme.
 - 2. Engineer Approved Equal.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.
- D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.
 - 1. Number of Terminals per Field: One for each conductor in assigned cables.
- E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
 - 1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
- F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- G. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with eight-position modular plug at each end.
 - 1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.
 - 2. Patch cords shall have color-coded boots for circuit identification.

2.4 OPTICAL FIBER CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CommScope, Inc.
 - 2. Corning Cable Systems.
 - 3. General Cable Technologies Corporation.
 - 4. Mohawk; a division of Belden CDT.
 - 5. Nordex/CDT; a subsidiary of Cable Design Technologies.
 - 6. Superior Essex Inc.
 - 7. SYSTIMAX Solutions; a CommScope, Inc. brand.
 - 8. 3M.
 - 9. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
 - 10. Engineer Approved Equal.
- B. Description: Multimode, 50/125-micrometer, 6-fiber, nonconductive, tight buffer, optical fiber cable.
 - 1. Comply with ICEA S-83-596 for mechanical properties.
 - 2. Comply with TIA/EIA-568-B.3 for performance specifications.

3. Comply with TIA/EIA-492AAAA-B for detailed specifications.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
 - a. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
 - b. Riser Rated, Nonconductive: Type or OFNP, complying with UL 1666.
5. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
6. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

C. Jacket:

1. Jacket Color: Aqua for 50/125-micrometer cable.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.5 OPTICAL FIBER CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Corning Cable Systems.
2. Hubbell Premise Wiring.
3. Molex Premise Networks; a division of Molex, Inc.
4. Nordex/CDT; a subsidiary of Cable Design Technologies.
5. Optical Connectivity Solutions Division; Emerson Network Power.
6. Engineer Approved Equal.

B. Cross-Connects and Patch Panels: Modular panels housing multiple-numbered, duplex cable connectors.

1. Number of Connectors per Field: One for each fiber of cable or cables assigned to field, plus spares and blank positions adequate to suit specified expansion criteria.

C. Patch Cords: Factory-made, dual-fiber cables in 36-inch lengths.

D. Cable Connecting Hardware:

1. Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.
2. Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.
3. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.6 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.

B. Workstation Outlets: Four-port-connector assemblies mounted in single faceplate.

1. Metal Faceplate: Stainless steel, complying with requirements in Section 26 2726 "Wiring Devices."
2. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.
3. Legend: Machine printed, in the field, using adhesive-tape label.

2.7 GROUNDING

A. Comply with requirements in Section 26 0526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

- B. Comply with ANSI-J-STD-607-A.

2.8 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Section 26 0553 "Identification for Electrical Systems."

2.9 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
- E. Factory-sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- F. Cable will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Before installation, verify substrate and adjoining work is ready to receive installation of the Work under this Section, per Section 01 4000 – Quality Requirements, Article 3.3 Inspections.

3.2 ENTRANCE FACILITIES

- A. Coordinate backbone cabling with the protectors and demarcation point provided by communications service provider.

3.3 WIRING METHODS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces, in attics, and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Comply with requirements for raceways and boxes specified in Section 26 0533 "Raceway and Boxes for Electrical Systems."
- B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
- C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.4 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- B. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Section 27 1100 "Communications Equipment Room Fittings." Drawings indicate general arrangement of pathways and fittings.
- C. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- D. Comply with requirements in Section 26 0533 "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.
- E. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- F. Pathway Installation in Communications Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits 3 inches above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- G. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.5 INSTALLATION OF CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.
 - 4. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
 - 5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
 - 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
 - 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
 - 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
 - 10. In the communications equipment room, install a 10-foot-long service loop on each end of cable.
 - 11. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.
- C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
- D. Optical Fiber Cable Installation:
1. Comply with TIA/EIA-568-B.3.
 2. Cable may be terminated on connecting hardware that is rack or cabinet mounted.
- E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- F. Group connecting hardware for cables into separate logical fields.
- G. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.6 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.7 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with ANSI-J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.8 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."
 - 1. Administration Class: 1.
 - 2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Cable and Wire Identification:
 - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
 - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
 - 3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.
 - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
 - a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
 - b. Label each unit and field within distribution racks and frames.
 - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
- D. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
 - 1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:

1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
 2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 5. Optical Fiber Cable Tests:
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests
 - 1) Horizontal and multimode backbone link measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
 - 2) Attenuation test results for backbone links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.
 6. UTP Performance Tests:
 - a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
 - 1) Wire map.
 - 2) Length (physical vs. electrical, and length requirements).
 - 3) Insertion loss.
 - 4) Near-end crosstalk (NEXT) loss.
 - 5) Power sum near-end crosstalk (PSNEXT) loss.
 - 6) Equal-level far-end crosstalk (ELFEXT).
 - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
 - 8) Return loss.
 - 9) Propagation delay.
 - 10) Delay skew.
 7. Optical Fiber Cable Performance Tests: Perform optical fiber end-to-end link tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.3.
 8. Final Verification Tests: Perform verification tests for UTP and optical fiber systems after the complete communications cabling and workstation outlet/connectors are installed.
 - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
 - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- C. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

- D. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.10 POST-INSTALLATION REQUIREMENTS

- A. Clean the Work and affected adjacent materials per the manufacturer's written instructions.
- B. Protect the Work per Section 01 4000 – Quality Requirements, Article 3.5 Protection.
- C. Dispose of and manage construction waste per Section 01 7419 – Construction Waste Management.
- D. Instruct the Owner's personnel on the proper function and required periodic maintenance.

END OF SECTION

**SECTION 280500
COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY**

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 & 01 Specification Sections, apply to this Section. Any Contractor/Supplier who submits a bid, enters into a contract and/or provides work described in this Section acknowledges that they have read and understand all the requirements of Division 00 & 01 and this Section.
- B. Work Included:
 - 1. Electronic safety and security equipment coordination and installation.
 - 2. Common electronic safety and security installation requirements.

1.2 REFERENCES

- A. See Section 01 4200 – References, for all Abbreviations, Acronyms, ANSI & ASTM standards, Specialty Codes and Trade Practices that are referenced herein.
 - 1. Definitions:
 - a. See Section 01 4200 – References, for universal definitions related to the Work.
 - b. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - c. NBR: Acrylonitrile-butadiene rubber.
 - 2. Abbreviations and Acronyms listed
 - a. NECA National Electrical Contractors Association

1.3 QUALITY ASSURANCE

- A. See Section 01 4000 – Quality Requirements, for general quality criteria of the Work.
- B. Work to Conform to:
 - 1. ASTM Standards listed
 - a. ASTM A 53/A 53M – Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - b. ASTM C 1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
 - 2. Trade Practice Sections listed
 - a. NECA 1 – Standard Practices for Good Workmanship in Electrical Construction.
- C. Coordination and Pre-Installation Meeting
 - 1. See requirements in Section 01 3100 – Project Management and Coordination.
 - 2. Conduct pre-installation meeting one week before installation.
 - a. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
 - 1) To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2) To provide for ease of disconnecting the equipment with minimum interference to other installations.

- 3) To allow right of way for piping and conduit installed at required slope.
 - 4) So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- b. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
 - c. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
 - d. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

D. Warranty: Manufacturer's standard warranty.

1.4 SUBMITTALS

- A. All submittals under the provisions of Section 01 3300 – Submittal Procedures, unless noted otherwise. Refer to Section 01 3300 – Submittal Procedures, Paragraph 3.1, for descriptions of submittal items. Submittals listed below are required:
 - 1. Product Data: For sleeve seals.
 - 2. Warranty.

PART 2 - PRODUCT

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers. Retain one of first two subparagraphs and list of manufacturers below. See Division 01 Section "Product Requirements."
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Engineer Approved Equal.

3. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
4. Pressure Plates: Carbon steel. Include two for each sealing element.
5. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Before installation, verify substrate and adjoining work is ready to receive installation of the Work under this Section, per Section 01 4000 – Quality Requirements, Article 3.3 Inspections.

3.2 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.3 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic safety and security installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.4 POST-INSTALLATION REQUIREMENTS

- A. Clean the Work and affected adjacent materials per the manufacturer's written instructions.
- B. Protect the Work per Section 01 4000 – Quality Requirements, Article 3.5 Protection.
- C. Dispose of and manage construction waste per Section 01 7419 – Construction Waste Management.
- D. Instruct the Owner's personnel on the proper function and required periodic maintenance.

END OF SECTION

SECTION 280513
CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 & 01 Specification Sections, apply to this Section. Any Contractor/Supplier who submits a bid, enters into a contract and/or provides work described in this Section acknowledges that they have read and understand all the requirements of Division 00 & 01 and this Section.

- B. Work Included:
 - 1. UTP cabling.
 - 2. Coaxial cabling.
 - 3. RS-232 cabling.
 - 4. RS-485 cabling.
 - 5. Low-voltage control cabling.
 - 6. Control-circuit conductors.
 - 7. Fire alarm wire and cable.
 - 8. Identification products.

1.2 REFERENCES

- A. See Section 01 4200 – References, for all Abbreviations, Acronyms, ANSI & ASTM standards, Specialty Codes and Trade Practices that are referenced herein.

- B. Definitions:
 - 1. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
 - 2. BICSI: Building Industry Consulting Service International.
 - 3. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.
 - 4. EMI: Electromagnetic interference.
 - 5. IDC: Insulation displacement connector.
 - 6. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
 - 7. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
 - 8. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).
 - 9. RCDD: Registered Communications Distribution Designer.
 - 10. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.
 - 11. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.
 - 12. UTP: Unshielded twisted pair.

- C. Abbreviations and Acronyms
 - 1. ANSI American National Standards Institute
 - 2. BICSI Building Industry Consulting Service International, Inc.
 - 3. EIA Electronic Industries Alliance
 - 4. ICEA Insulated Cable Engineers Association
 - 5. NECA National Electrical Contractors Association
 - 6. NEMA National Electrical Manufacturers Association
 - 7. NFPA National Fire Protection Association

8. TIA Telecommunications Industry Association

1.3 QUALITY ASSURANCE

- A. See Section 01 4000 – Quality Requirements, for general quality criteria of the Work.
- B. Work to Conform to
1. ANSI Standards
 - a. ANSI-J-STD-607-A – Commercial Building Grounding (Earthing) and Bonding Requirements For Telecommunications
 2. ASTM Standards
 - a. ASTM A123/A123M – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - b. ASTM B633 – Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
 - c. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials
 3. Trade Practice
 - a. ICEA S-83-596 – Standard for Indoor Optical Fiber Cable
 - b. ICEA S-90-661 – Category 3, 5 & 5e Individually Unshielded Twisted Pair Indoor Cables for use in General Purpose and LAN Communications Wiring Systems
 - c. NECA 1 – Standard Practices for Good Workmanship in Electrical Construction
 - d. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)
 - e. NEMA VE 2 – Cable Tray Installation Guidelines
 - f. NFPA 70 – National Electrical Code
 - g. NFPA 72 – Protective Signaling Systems
 - h. NFPA 262 – Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces
 - i. TIA/EIA-526-14-A – Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
 - j. TIA/EIA-568-B.1 – Commercial Building Telecommunications Cabling Standard: General Requirements
 - k. TIA/EIA-568-B.2 – Commercial Building Telecommunications Cabling Standard: 100-Ohm Balanced Twisted-Pair Cabling Standard
 - l. TIA/EIA-568-B.3 – Commercial Building Telecommunications Cabling Standard: Optical Fiber Cabling Component Standard
 - m. TIA/EIA-569 – Commercial Building Standard for Telecommunications Pathways and Spaces
 - n. TIA/EIA-598-B – Optical Fiber Cable Color Coding
 - o. TIA/EIA-604-2 – Fiber Optic Connector Intermateability Standard
 - p. TIA/EIA-604-3-A – Fiber Optic Connector Intermateability Standard, Type SC
 - q. TIA/EIA-604-12 – Fiber Optic Connector Intermateability Standard Type MT-RJ
 - r. TIA/EIA-606-A – Administration Standard for Commercial Telecommunications Infrastructure
 - s. UL 83 – Thermoplastic-Insulated Wires and Cables
 - t. UL 444 – Communications Cables
 - u. UL 969 – Standard for Marking and Labeling Systems
 - v. UL 1424 – Standard for Cables for Power-Limited Fire-Alarm Circuits
 - w. UL 1581 – Reference Standard for Electrical Wires, Cables, and Flexible Cords
 - x. UL 1651 – Standard for Optical Fiber Cable
 - y. UL 1655 – Standard for Community-Antenna Television Cables
 - z. UL 1666 – Standard for Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
 - aa. UL 2196 – Standard for Tests for Fire Resistive Cables

4. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 50 or less.
 5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 6. Testing Agency Qualifications: An NRTL.
 - a. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.
- C. Project Conditions/ Environmental Controls
1. Test cables upon receipt at Project site.
 - a. Test each pair of UTP cable for open and short circuits.
 2. Do not deliver or install UTP and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- D. Coordination and Pre-Installation Meeting
1. See requirements in Section 01 3100 – Project Management and Coordination.
 2. Conduct pre-installation meeting one week before installation.
- E. Warranty: Manufacturer's standard warranty.

1.4 SUBMITTALS

- A. All submittals under the provisions of Section 01 3300 – Submittal Procedures, unless noted otherwise. Refer to Section 01 3300 – Submittal Procedures, Paragraph 3.1, for descriptions of submittal items. Submittals listed below are required:
1. Product Data: For each type of product indicated.
 - a. For coaxial cable, include the following installation data for each type used:
 - 1) Nominal OD.
 - 2) Minimum bending radius.
 - 3) Maximum pulling tension.
 2. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
 3. Field quality-control reports.
 4. Maintenance Data: For wire and cable to include in maintenance manuals.
 5. Warranty.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. Support of Open Cabling: NRTL labeled for support of Category 5e cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
1. Support brackets with cable tie slots for fastening cable ties to brackets.
 2. Lacing bars, spools, J-hooks, and D-rings.
 3. Straps and other devices.

- B. Besides two corrosion-protection options in subparagraph below, alternative methods include trays fabricated from Types 304 and 316 stainless steel, steel with electrogalvanized zinc plating then coated with yellow dichromate, steel coated with PVC, and steel with powder coating,
- C. Conduit and Boxes: Comply with requirements in Section 260 0533 "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
 - 1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

2.2 UTP CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Belden CDT Inc.; Electronics Division.
 - 2. Berk-Tek; a Nexans company.
 - 3. CommScope, Inc.
 - 4. Genesis Cable Products; Honeywell International, Inc.
 - 5. Superior Essex Inc.
 - 6. 3M.
 - 7. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
 - 8. Engineer Approved Equal.
- B. Description: 100-ohm, 4-pair UTP, formed into 25-pair binder groups covered with a blue thermoplastic jacket.
 - 1. Comply with ICEA S-90-661 for mechanical properties.
 - 2. Comply with TIA/EIA-568-B.1 for performance specifications.
 - 3. Comply with TIA/EIA-568-B.2, Category 5e.
 - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
 - a. Communications, General Purpose: Type CM or CMG.
 - b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
 - c. Communications, Riser Rated: Type CMR, complying with UL 1666.
 - d. Communications, Limited Purpose: Type CMX.
 - e. Multipurpose: Type MP or MPG.
 - f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
 - g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.3 UTP CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hubbell Premise Wiring.
 - 2. Leviton Voice & Data Division.
 - 3. Nordex/CDT; a subsidiary of Cable Design Technologies.
 - 4. Panduit Corp.
 - 5. Engineer Approved Equal.
- B. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.
- C. Connecting Blocks: 110-style for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

2.4 COAXIAL CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Belden CDT Inc.; Electronics Division.

2. CommScope, Inc.
 3. Engineer Approved Equal.
- B. General Coaxial Cable Requirements: Broadband type, recommended by cable manufacturer specifically for broadband data transmission applications. Coaxial cable and accessories shall have 75-ohm nominal impedance with a return loss of 20 dB maximum from 7 to 806 MHz.
- C. RG-6/U: NFPA 70, Type CATV or CM.
1. No. 16 AWG, solid, copper-covered steel conductor; gas-injected, foam-PE insulation.
 2. Double shielded with 100 percent aluminum-foil shield and 60 percent aluminum braid.
 3. Jacketed with black PVC or PE.
 4. Suitable for indoor installations.
- D. NFPA and UL compliance, listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1655, and with NFPA 70 "Radio and Television Equipment" and "Community Antenna Television and Radio Distribution" Articles. Types are as follows:
1. CATV Cable: Type CATV.
 2. CATV Plenum Rated: Type CATVP, complying with NFPA 262.
 3. CATV Riser Rated: Type CATVR, complying with UL 1666.
 4. CATV Limited Rating: Type CATVX.

2.5 COAXIAL CABLE HARDWARE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Aim Electronics; a brand of Emerson Electric Co.
 2. Leviton Voice & Data Division.
 3. Engineer Approved Equal.
- B. Coaxial-Cable Connectors: Type BNC, 75 ohms.

2.6 RS-232 CABLE

- A. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 2. Plastic insulation.
 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
 4. Plastic jacket.
 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
 6. Flame Resistance: Comply with NFPA 262.

2.7 RS-485 CABLE

- A. Plenum-Rated Cable: NFPA 70, Type CMP.
1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
 2. Fluorinated ethylene propylene insulation.
 3. Unshielded.
 4. Fluorinated ethylene propylene jacket.
 5. Flame Resistance: NFPA 262, Flame Test.

2.8 LOW-VOLTAGE CONTROL CABLE

- A. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.
1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
 2. PVC insulation.
 3. Unshielded.

4. PVC jacket.
 5. Flame Resistance: Comply with NFPA 262.
- B. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.
1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
 2. Fluorinated ethylene propylene insulation.
 3. Unshielded.
 4. Plastic jacket.
 5. Flame Resistance: NFPA 262, Flame Test.

2.9 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.
- B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.

2.10 FIRE ALARM WIRE AND CABLE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Comtran Corp.
 2. Draka USA.
 3. Genesis Cable Products; Honeywell International, Inc.
 4. Rockbestos-Suprenant Cable Corporation.
 5. West Penn Wire/CDT; a division of Cable Design Technologies.
 6. Engineer Approved Equal.
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG.
1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a 2-hour rating.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
1. Low-Voltage Circuits: No. 16 AWG, minimum.
 2. Line-Voltage Circuits: No. 12 AWG, minimum.
 3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NRTL listed for fire alarm and cable tray installation, plenum rated, and complying with requirements in UL 2196 for a 2-hour rating.

2.11 IDENTIFICATION PRODUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brady Corporation
 2. HellermannTyton.
 3. Kroy LLC.
 4. Panduit Corp.
 5. Engineer Approved Equal.

- B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- C. Comply with requirements in Section 26 0553 "Identification for Electrical Systems."

2.12 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- C. Factory test UTP cables according to TIA/EIA-568-B.2.
- D. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- E. Cable will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Before installation, verify substrate and adjoining work is ready to receive installation of the Work under this Section, per Section 01 4000 – Quality Requirements, Article 3.3 Inspections.

3.2 INSTALLATION OF PATHWAYS

- A. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- B. Comply with requirements in Section 26 0533 "Raceway and Boxes for Electrical Systems." for installation of conduits and wireways.
- C. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- D. Pathway Installation in Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard when entering room from overhead.
 - 4. Extend conduits 3 inches above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA/EIA-568-B.1.
 - 2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
 - 3. Install 110-style IDC termination hardware unless otherwise indicated.

4. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
9. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
3. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 FIRE ALARM WIRING INSTALLATION

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method: Install wiring in metal raceway according to Section 26 0533 "Raceway and Boxes for Electrical Systems."
 - 1. Install plenum cable in environmental air spaces, including plenum ceilings.
 - 2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.
- C. Wiring Method:
 - 1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
 - 2. Fire-Rated Cables: Use of 2-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is permitted with written consent from local Authority Having Jurisdiction.
 - 3. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or raceway as signaling line circuits.
- D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.
- H. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 CONTROL-CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:
 - 1. Class 1 remote-control and signal circuits, No. 14 AWG.
 - 2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
 - 3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

3.6 CONNECTIONS

- A. Comply with requirements in Division 28 Section "Fire Detection and Alarm" for connecting, terminating, and identifying wires and cables.

3.7 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA/EIA-569-A, "Firestopping" Annex A.
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.8 GROUNDING

- A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. For low-voltage wiring and cabling, comply with requirements in Section 26 0526 "Grounding and Bonding for Electrical Systems."

3.9 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

3.10 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Visually inspect UTP cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
 - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 - 3. Test UTP cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- C. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- D. See Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.
- E. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.11 POST-INSTALLATION REQUIREMENTS

- A. Clean the Work and affected adjacent materials per the manufacturer's written instructions.
- B. Protect the Work per Section 01 4000 – Quality Requirements, Article 3.5 Protection.

- C. Dispose of and manage construction waste per Section 01 7419 – Construction Waste Management.
- D. Instruct the Owner's personnel on the proper function and required periodic maintenance.

END OF SECTION

SECTION 283111
DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General Conditions and Division 00 & 01 Specification Sections, apply to this Section. Any Contractor/Supplier who submits a bid, enters into a contract and/or provides work described in this Section acknowledges that they have read and understand all the requirements of Division 00 & 01 and this Section.

- B. System Description:
 - 1. Noncoded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.
 - 2. Noncoded addressable system, with automatic sensitivity control of certain smoke detectors and multiplexed signal transmission, dedicated to fire-alarm service only.

- C. Work Included:
 - 1. Fire-alarm control unit.
 - 2. Manual fire-alarm boxes.
 - 3. System smoke detectors.
 - 4. Heat detectors.
 - 5. Notification appliances.
 - 6. Magnetic door holders.
 - 7. Remote annunciator.
 - 8. Addressable interface device.
 - 9. Digital alarm communicator transmitter.

1.2 REFERENCES

- A. See Section 01 4200 – References, for all Abbreviations, Acronyms, ANSI & ASTM standards, Specialty Codes and Trade Practices that are referenced herein.

- B. Definitions
 - 1. See Section 01 4200 – References, for universal definitions related to the Work.
 - 2. LED: Light-emitting diode.
 - 3. Withstand: The unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified.

- C. Abbreviations and Acronyms
 - 1. ANSI American National Standards Institute
 - 2. ASCE American Society of Civil Engineers
 - 3. IEEE Institute of Electrical and Electronics Engineers
 - 4. NEMA National Electrical Manufacturers Association
 - 5. NFPA National Fire Protection Association
 - 6. NICET National Institute for Certification in Engineering Technologies
 - 7. SEI Structural Engineering Institute

1.3 QUALITY ASSURANCE

- A. See Section 01 4000 – Quality Requirements, for general quality criteria of the Work.

- B. Work to Conform to:
 - 1. ANSI Standards

- a. ANSI S1.4 – Specification for Sound Level Meters
- 2. Specialty Code
 - a. 47 CFR 90 – FCC - Private Land Mobile Radio Services
- 3. Trade Practice
 - a. IEEE 1100 – Recommended Practice for Powering and Grounding Electronic Equipment
 - b. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)
 - c. NFPA 25 – Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems
 - d. NFPA 70 – National Electrical Code
 - e. NFPA 72 – National Fire Alarm Code
 - f. NFPA 90A – Standard for the Installation of Air Conditioning and Ventilating Systems
 - g. NFPA 101 – Safety to Life from Fire in Buildings and Structures
 - h. NFPA 1221 – Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems
 - i. SEI/ASCE 7 – Minimum Design Loads for Buildings and Other Structures
 - j. UL 38 – Standard for Manual Signaling Boxes for Fire Alarm Systems
 - k. UL 217 – Standard for Smoke Alarms
 - l. UL 268 – Smoke Detectors for Fire Alarm Systems
 - m. UL 268A – Standard for Smoke Detectors for Duct Application
 - n. UL 464 – Standard for Audible Signal Appliances
 - o. UL 521 – Standard for Heat Detectors for Fire Protective Signaling Systems
 - p. UL 632 – Standard for Electrically-Actuated Transmitters
 - q. UL 864 – Standard for Control Units and Accessories for Fire Alarm Systems
 - r. UL 1480 – Standard for Speakers for Fire Alarm, Emergency, and Commercial and Professional Use
 - s. UL 1711 – Standard for Amplifiers for Fire Protective Signaling Systems
 - t. UL 1971 – Standard for Signaling Devices for the Hearing Impaired
- 4. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.
- 5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- 6. Retain one of four paragraphs below to require independent system verification.
- 7. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL.
- 8. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.
- 9. NFPA Certification: Obtain certification according to NFPA 72 in the form of a placard by an FMG-approved alarm company.
- 10. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

C. Installer Qualifications:

- 1. Trained and certified by manufacturer for installation of units required for this Project.
- 2. Personnel certified by NICET as fire-alarm Level II technician.

D. Shop Drawing Preparation Qualifications:

- 1. Trained and certified by manufacturer in fire-alarm system design.
- 2. Licensed or certified by authorities having jurisdiction.

E. Project Conditions/ Environmental Controls:

- 1. Existing Fire-Alarm Equipment:
 - a. Maintain existing equipment fully operational until new equipment has been tested and accepted.
 - b. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted.

- c. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.
2. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

F. Warranty: Manufacturer's standard warranty.

1.4 SUBMITTALS

- A. All submittals under the provisions of Section 01 3300 – Submittal Procedures, unless noted otherwise. Refer to Section 01 3300 – Submittal Procedures, Paragraph 3.1, for descriptions of submittal items. Submittals listed below are required:
 1. Approval by authorities having jurisdiction prior to submitting them to Architect.
 2. Product Data: For each type of product indicated.
 3. Shop Drawings:
 - a. For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
 - b. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
 - c. Include voltage drop calculations for notification appliance circuits.
 - d. Include battery-size calculations.
 - e. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 - f. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
 - g. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
 - h. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
 - i. Include floor plans from computer simulation indicating point-by-point decibel levels of all audible annunciation devices and candela of all strobe devices, using 5'-0" by 5'-0" spacing. Provide additional devices as required to maintain at least 15dBA above ambient sound levels during normal occupied facility hours.
 4. Delegated-Design Submittal: For smoke and heat detectors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - a. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.
 - b. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.
- B. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
 3. Record copy of site-specific software.
 4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:

- a. Frequency of testing of installed components.
 - b. Frequency of inspection of installed components.
 - c. Requirements and recommendations related to results of maintenance.
 - d. Manufacturer's user training manuals.
- 5. Manufacturer's required maintenance related to system warranty requirements.
 - 6. Abbreviated operating instructions for mounting at fire-alarm control unit.
 - 7. Copy of NFPA 25.
- C. Software and Firmware Operational Documentation:
- 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
 - 3. Device address list.
- D. Warranty
- E. Extra Stock
- 1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - a. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
 - b. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
 - c. Smoke Detectors, Fire Detectors, and Flame Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
 - d. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
 - e. Keys and Tools: One extra set for access to locked and tamperproofed components.
 - f. Audible and Visual Notification Appliances: One of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Fire Control Instruments, Inc.; a Honeywell company.
 - 2. NOTIFIER; a Honeywell company.
 - 3. Siemens Building Technologies, Inc.; Fire Safety Division.
 - 4. SimplexGrinnell LP; a Tyco International company.
 - 5. Edwards EST3X; Edwards Fire Safety.
 - 6. Autocall; a Johnson Controls Company.
 - 7. Engineer Approved Equal.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices:
- 1. Manual stations.
 - 2. Heat detectors.
 - 3. Smoke detectors.
 - 4. Duct smoke detectors.
 - 5. Verified automatic alarm operation of smoke detectors.
 - 6. Automatic sprinkler system water flow.
 - 7. Heat detectors in elevator shaft and pit.
 - 8. Fire-extinguishing system operation.
 - 9. Fire standpipe system.

- B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances.
 2. Identify alarm at fire-alarm control unit and remote annunciators.
 3. Transmit an alarm signal to the remote alarm receiving station.
 4. Unlock electric door locks in designated egress paths.
 5. Release fire and smoke doors held open by magnetic door holders.
 6. Activate voice/alarm communication system.
 7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
 8. Close smoke dampers in air ducts of designated air-conditioning duct systems.
 9. Recall elevators to primary or alternate recall floors.
 10. Activate emergency lighting control.
 11. Activate emergency shutoffs for gas and fuel supplies.
 12. Record events in the system memory.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
 2. Low-air-pressure switch of a dry-pipe sprinkler system.
 3. Elevator shunt-trip supervision.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
 2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 3. Loss of primary power at fire-alarm control unit.
 4. Ground or a single break in fire-alarm control unit internal circuits.
 5. Abnormal ac voltage at fire-alarm control unit.
 6. Break in standby battery circuitry.
 7. Failure of battery charging.
 8. Abnormal position of any switch at fire-alarm control unit or annunciator.
 9. Fire-pump power failure, including a dead-phase or phase-reversal condition.
 10. Low-air-pressure switch operation on a dry-pipe or preaction sprinkler system.
- E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.

2.3 FIRE-ALARM CONTROL UNIT

- A. General Requirements for Fire-Alarm Control Unit:
1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
 - a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
 - b. Include a real-time clock for time annotation of events on the event recorder and printer.
 2. Addressable initiation devices that communicate device identity and status.
 - a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
 - b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
 3. Addressable control circuits for operation of mechanical equipment.
- B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 2 line(s) of 40 characters, minimum.
 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.
- C. Circuits:
1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.
 - a. Initiating Device Circuits: Style D.
 - b. Notification Appliance Circuits: Style Z.
 - c. Signaling Line Circuits: Style 2.
 - d. Install no more than 100 addressable devices on each signaling line circuit.
- D. Smoke-Alarm Verification:
1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
 2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
 3. Sound general alarm if the alarm is verified.
 4. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.
- E. Elevator Recall:
1. Smoke detectors at the following locations shall initiate automatic elevator recall. Alarm-initiating devices, except those listed, shall not start elevator recall.
 - a. Elevator lobby detectors except the lobby detector on the designated floor.
 - b. Smoke detector in elevator machine room.
 - c. Smoke detectors in elevator hoistway.
 2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
 3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
 - a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.
- F. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke barrier walls shall be connected to fire-alarm system.
- G. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.
- H. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- I. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.
1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.
 - a. Allow the application of and evacuation signal to indicated number of zones and, at same time, allow voice paging to the other zones selectively or in any combination.
 - b. Programmable tone and message sequence selection.
 - c. Standard digitally recorded messages for "Evacuation" and "All Clear."

- d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.
- 2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
- 3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
- J. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.
 - 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- K. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
 - 1. Batteries: Sealed, valve-regulated, recombinant lead acid & Vented, wet-cell pocket, plate nickel cadmium.
- L. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

- A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
 - 1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 - 2. Station Reset: Key- or wrench-operated switch.
 - 3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
 - 4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.5 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
 - 1. Comply with UL 268; operating at 24-V dc, nominal.
 - 2. Detectors shall be two-wire type.
 - 3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 - 4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
 - 5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - 6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.

7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
 - b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
 - c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

C. Ionization Smoke Detector:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).

D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
 - a. Primary status.
 - b. Device type.
 - c. Present average value.
 - d. Present sensitivity selected.
 - e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.6 HEAT DETECTORS

- A. General Requirements for Heat Detectors: Comply with UL 521.
- B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- C. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.
1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, equipped for mounting as indicated and with screw terminals for system connections.
- B. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.
1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.
- C. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.
- D. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.
- E. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.
- F. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.
1. Rated Light Output:
 - a. 15/30/75/110 cd, selectable in the field.
 2. Mounting: Wall mounted unless otherwise indicated.
 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 4. Flashing shall be in a temporal pattern, synchronized with other units.
 5. Strobe Leads: Factory connected to screw terminals.
 6. Mounting Faceplate: Factory finished, white.
- G. Voice/Tone Notification Appliances:
1. Appliances shall comply with UL 1480 and shall be listed and labeled by an NRTL.
 2. High-Range Units: Rated 2 to 15 W.
 3. Low-Range Units: Rated 1 to 2 W.
 4. Mounting: Flush.
 5. Matching Transformers: Tap range matched to acoustical environment of speaker location.

2.8 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.

1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.
2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
3. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.9 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Flush cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.10 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

2.11 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture one telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that both telephone lines are available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:

1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply or loss of power.
5. Low battery.
6. Abnormal test signal.
7. Communication bus failure.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Before installation, verify substrate and adjoining work is ready to receive installation of the Work under this Section, per Section 01 4000 – Quality Requirements, Article 3.3 Inspections.

3.2 EQUIPMENT INSTALLATION

- A. General: Install according to the manufacturer's written instructions/ recommendations approved during the shop drawing submittal process.
- B. Comply with NFPA 72 for installation of fire-alarm equipment.
- C. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches above the finished floor.
- D. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.
- E. Smoke- or Heat-Detector Spacing:
 - 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 - 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.
 - 3. Smooth ceiling spacing shall not exceed 30 feet.
 - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.
 - 5. HVAC: Locate detectors not closer than 5 feet from air-supply diffuser or return-air opening.
 - 6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.
- F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- G. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.
- H. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- I. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- J. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling.
- K. Device Location-Indicating Lights: Locate in public space near the device they monitor.
- L. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches above the finished floor.
- M. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

3.3 CONNECTIONS

- A. Coordinate installation and specialty arrangements with Drawings and with requirements specified in related Sections. If Drawings are explicit enough, these requirements may be reduced or omitted.
- B. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 08 Section "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- C. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
 - 1. Smoke dampers in air ducts of designated air-conditioning duct systems.
 - 2. Alarm-initiating connection to elevator recall system and components.
 - 3. Alarm-initiating connection to activate emergency lighting control.
 - 4. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
 - 5. Supervisory connections at valve supervisory switches.
 - 6. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
 - 7. Supervisory connections at elevator shunt trip breaker.
 - 8. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
 - 9. Supervisory connections at fire-pump engine control panel.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.5 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.6 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Tests and Inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 - 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
 5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- E. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

3.7 POST-INSTALLATION REQUIREMENTS

- A. Clean the Work and affected adjacent materials per the manufacturer's written instructions.
- B. Protect the Work per Section 01 4000 – Quality Requirements, Article 3.5 Protection.
- C. Dispose of and manage construction waste per Section 01 7419 – Construction Waste Management.
- D. Instruct the Owner's personnel on the proper function and required periodic maintenance.
1. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.
- E. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- F. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.
- G. Technical Support: Beginning with Substantial Completion, provide software support for two years.
- H. Software:
1. Update software to latest version at Project completion.
 2. Install and program software upgrades that become available within two years from date of Substantial Completion.
 3. Upgrading software shall include operating system.
 4. Upgrade shall include new or revised licenses for use of software.
 5. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

END OF SECTION

SECTION 03 11 00 CONCRETE FORMWORK

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the contract, including General and Supplementary Conditions, apply to the work specified in this section.
- B. Related Work specified elsewhere:
 - 1. Concrete Reinforcement - Section 03 20 00
 - 2. Concrete Joints and Water Stop - Section 03 15 00
 - 3. Cast-in-place Concrete - Section 03 30 00

1.02 DESCRIPTION OF WORK

- A. The extent of formwork is indicated by the concrete structures shown on the drawings.
- B. The work includes providing of the form work and shoring for cast-in-place concrete, and installation into formwork of items required such as anchor bolts, setting plates, bearing plates, anchorages, inserts, frames, nosings, and other items to be embedded in concrete (but not including reinforcing steel).

1.03 QUALITY ASSURANCE

- A. Examine the substrate and the conditions under which concrete formwork is to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected.
- B. Codes and Standards: Unless otherwise shown or specified, design, construct, erect, maintain, and remove forms and related structures for cast-in-place concrete work in compliance with the American Concrete Institute standard ACI 34, "Recommended Practice for Concrete Formwork."
- C. Allowable Tolerances: Construct formwork to provide completed cast-in-place concrete surfaces complying with the tolerances specified in ACI 347, and as follows:
 - 1. Variation from plumb in lines and surfaces of columns, piers, walls, and arises; ¼-inch per 10-foot, but not more than 1-inch total. For exposed corner columns, control joint grooves, and other conspicuous lines, ¼-inch in any bay or 20 feet maximum; ½-inch maximum in 40 feet or more.
 - 2. Variation from level or grade in slab soffits, ceilings, beam soffits, and in arises ¼-inch in 10 feet, 3/8-inch in any bay or 20 feet maximum and ¾-inch in 40 feet or more. For exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines, ¼ inch in any bay or 20 feet maximum, and ½-inch in 40 feet or more.
 - 3. Variation from position of the linear building lines and related columns, walls, and partitions, ½-inch in any bay or 20 feet maximum and 1-inch in 40 feet or more.
 - 4. Variation in sizes and locations of sleeves, floor openings, and wall openings, ¼-inch.
 - 5. Variation in cross sectional dimensions of columns and beams and thickness of slabs and walls, minus ¼-inch and plus ½-inch.
 - 6. Variations in footings plan dimensions, minus ½-inch and plus 2-inch misplacement or eccentricity, 2% of the footing width in direction of misplacement but not more than 2-inch thickness reduction, minus 5%.
 - 7. Variation in steps: in a flight of stairs, 1/8-inch for rise and ¼-inch for treads; in consecutive steps, 1/16-inch for rise and 1/8-inch for treads.
- D. Before concrete placement, check the lines and levels of erected formwork. Make corrections and adjustments to ensure proper size and location of concrete members and stability of forming systems.

- E. During concrete placement, check formwork and related supports to ensure that forms are not displaced and that completed work will be within specified tolerances.

PART 2 PRODUCTS

2.01 FORM MATERIALS

- A. Unless otherwise shown or specified, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed, plywood-faced, or other panel type materials acceptable to Engineer to provide continuous, straight, smooth, as-cast surfaces. Furnish in largest practicable sizes to minimize number of joints. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.
- B. Form concrete surfaces, which will be unexposed in the finished structure with plywood, lumber, metal, or other acceptable material. Provide lumber that is dressed on at least two edges and one side for tight fit.
- C. Form ties shall be of removable end, permanently embedded body type and shall have sufficient strength and rigidity to support and maintain the form in proper position and alignment without the use of auxiliary spreaders. Unless otherwise shown, cones shall be provided on the outer ends of each tie and the permanently embedded portion shall be at least 1-inch back from the concrete face. Form ties for water bearing walls shall be provided with water seal washers located on the permanently embedded portions of the ties at the approximate center of the wall. Permanently embedded portions of form ties that are not provided with threaded ends shall be constructed so that the removable ends are readily broken off without damage to the concrete. The type of form ties used shall be acceptable to the Engineer. Form ties fabricated on the project site and the wire ties are not acceptable.
- D. Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.
- E. Provide metal inserts for anchorage of materials or equipment to concrete construction not supplied by other trades and as required for the work.

2.02 FORMS FOR PAVEMENT, SIDEWALK, AND CURB & GUTTER

- A. Forms shall have a depth not less than the prescribed edge thickness of the pavement. Built up forms with horizontal joints shall not be used.
- B. When staked in place, forms shall withstand the pressure of the concrete and the impact and vibration of any equipment they are required to support, without significant springing, settlement, or lateral displacement.
- C. Bent, twisted, or broken forms and those with battered top surfaces shall be removed from the work. Repaired forms shall not be used until inspected and approved.
- D. The top face of any form shall not vary from a true plane by more than 1/8-inch in 10 feet, nor shall the contact face of a straight form vary from a true plane by more than 1/4-inch in 10 feet.
- E. Straight forms shall be metal having a thickness of not less than 1/4-inch and shall be furnished in sections not less than 10 feet in length. Each section shall have provisions for locking together the ends of abutting sections. Straight forms shall have a base width of at least eight inches with flange braces extending outward on the base at least 2/3 the height of the form.
- F. Flexible or curved forms of proper radius shall be used for curves of 100-foot radius or less. Flexible or curved forms shall be of an acceptable design.

2.03 DESIGN OF FORMWORK

- A. Design, erect, support, brace, and maintain formwork so that it will safely support vertical and lateral loads that might be applied, until such loads can be supported by the concrete structure. Carry vertical and lateral loads to ground by formwork system and in-place construction that has attained adequate strength for that purpose. Construct formwork so that concrete members and structures are of correct size, shape, alignment, elevation, and position.
- B. Design forms and false work to include assumed values of live load, dead load, weight of moving equipment operated on formwork, concrete mix, height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, stresses, lateral stability, and other factors pertinent to safety of structure during construction.
- C. Provide shores and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof. Provide trussed supports when adequate foundations for shores and struts cannot be secured.
- D. Support form facing materials by structural members spaced sufficiently close to prevent deflection. Fit forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities and within allowable tolerances. Provide camber in formwork as required for anticipated deflections due to weight and pressures of fresh concrete and construction loads for long span members without intermediate supports.
- E. Provide temporary openings in wall forms, column forms and at other locations necessary to permit inspection and cleanout.
- F. Design formwork to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.
- G. Provide formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins.
- H. Side forms of footings may be omitted and concrete placed directly against excavation only when requested by Contractor and accepted by Engineer. When omission of forms is accepted, provide additional concrete required beyond the minimum design profiles and dimensions of the footings as detailed.

PART 3 EXECUTION

3.01 FORM CONSTRUCTION

- A. Construct forms complying with ACI 347, to the exact sizes, shapes, lines, and dimensions shown and as required to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required. Use selected materials to obtain required finishes.
- B. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where the slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and assure ease of removal.
- C. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Brace temporary closures and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms in as inconspicuous location as possible, consistent with project requirements.
- D. Form intersecting planes to provide true, clean cut corners, with edge grain of plywood not exposed as form for concrete.
- E. Provide openings in forms to accommodate other work, including mechanical and electrical work. Accurately place and securely support items required to be built into the forms.
- F. False work:
 - 1. Erect false work and support, brace, and maintain it to safely support vertical, lateral, and asymmetrical loads applied until such loads can be supported by in-place concrete structures. Construct false work so that adjustments can be made for take-up and settlement.
 - 2. Provide wedges, jacks, or camber strips to facilitate vertical adjustments. Carefully inspect false work and formwork during and after concrete placement operations to determine abnormal deflection or signs of failure; make necessary adjustments to produce work of required dimensions.
- G. Forms for Exposed Concrete:
 - 1. Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Do not splinter forms by driving ties through improperly prepared holes.
 - 2. Do not use metal cover plates for patching holes or defects in forms.
 - 3. Provide sharp, clean corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, square intersections.
 - 4. Use extra studs, walers, and bracing to prevent bowing of forms between studs and to avoid bowed appearance in concrete. Do not use narrow strips of form material that will produce bow.
 - 5. Assemble forms so they may be readily removed without damage to exposed concrete surfaces.
 - 6. Form molding shapes, recesses, and projections with smooth finish materials, and install in forms with sealed joints to prevent displacement.
- H. Corner Treatment:
 - 1. Form exposed corners of beams and columns to produce square, smooth, solid, unbroken lines, except as otherwise shown.
 - 2. Form chamfers with $\frac{3}{4}$ inch x $\frac{3}{4}$ inch strips unless otherwise shown, accurately formed and surface to produce uniformly straight lines and tight edge joints. Extend terminal edges to the required limit and miter chamfer strips at changes in direction.

3. Unexposed corners may be formed either square or chamfered.

- I. See Section 03 15 00 for treatment of control and construction joints. Locate as indicated.
- J. Provide openings in concrete formwork to accommodate work of other trades, including those under separate prime contracts (if any). Size and location of openings, recesses, and chases are the responsibility of the trade requiring such items. Accurately place and securely support items to be built into forms.
- K. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is to be placed. Retighten forms immediately after concrete placement as required to eliminate mortar leaks.

3.02 FORM COATINGS

- A. Coat form contact surfaces with form-coating compound before reinforcement is placed. Do not allow excess form coating material to accumulate in the forms or to come into contact with surfaces that will be bonded to fresh concrete. Apply in compliance with manufacturer's instructions.
- B. Coat steel forms with a non-staining, rust preventative form oil or otherwise protect against rusting. Rust-stained steel formwork is not acceptable.

3.03 INSTALLATION OF EMBEDDED ITEMS

- A. Set and build into the work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of the items to be attached thereto.
- B. Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finished slab surface. Provide and secure units to support types of screeds required.

3.04 REMOVAL OF FORMS

- A. Formwork not supporting concrete, such as sides of beams, walls, columns, and similar parts of the work that may be removed after cumulatively curing at not less than 50 degrees F for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations and provided that curing and protection operations are maintained.
- B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements may not be removed in less than 14 days and not until concrete has attained design minimum 28-day compressive strength.
- C. Form facing material may be removed 4 days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

3.05 RE-USE OF FORMS

- A. Cleaned and repaired surfaces of forms may be re-used in the work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. Apply new form coating compound material to concrete contact surfaces as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close all joints. Align and secure joints to avoid offsets. Do not use "patched" forms for exposed concrete surfaces.

* * * END OF SECTION * * *

SECTION 03 15 00 CONCRETE JOINTS AND WATERSTOPS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the contract, including General and Supplementary Conditions, apply to the work specified in this section.
- B. Related Work Described Elsewhere:
 - 1. Concrete Formwork: 03 11 00
 - 2. Concrete Reinforcement: 03 20 00
 - 3. Cast-in-place Concrete: 03 30 00

1.02 DESCRIPTION OF WORK

- A. The extent of each type of concrete joint and waterstop required on foundation walls is shown on the drawings.

1.03 SUBMITTALS

- A. Manufacturer's catalog data and installation instructions.
- B. Certificate of compliance that waterstops meet or exceed physical property requirements of referenced specification.

PART 2 PRODUCTS

2.01 PREFORMED EXPANSION JOINT FILLER

- A. Preformed, non-extruding-type joint filler constructed of closed cell polyethylene foam of firm texture. Conform to ASTM D1752, Sections 3.1 to 3.4.

2.02 WATERSTOP

- A. Waterstop shall be extruded from virgin elastomeric PVC compound, resistant to chemical action with Portland cement, alkalis, acids, and fungi. Waterstop shall conform to Corps of Engineers CRD-C 572 and the following physical characteristics:

Physical Property Value Test Method

Sheet Material:

Tensile Strength, 2,100 psi ASTM D 412

Ultimate Elongation, 360 % ASTM D 412

Low Temperature Brittleness, -35 deg. F max ASTM D 746

Stiffness in Flexure, 750 psi min ASTM D 747

Finished Waterstop:

Tensile Strength, unaged 1750 psi min ASTM D412

Durometer Shore Hardness 70 ± 5 ASTM D1706

Ultimate Elongation, unaged 350% ASTM D412

- B. All waterstop shall be No 6380 as manufactured by W.R. Meadows, Serviced/Durajoint Type No. 5 as manufactured by W.R. Grace and company, or approved equal.

2.03 JOINT MATERIAL

- A. All joint material in contact with potable water shall meet requirements of the ND Dept of Environmental Quality and be safe for use with a drinking water supply.
- B. The backer rod shall be a non-moisture absorbing, resilient material approximately 25 percent larger in diameter than the width of the joint to be sealed. The backer rod shall be compatible with the sealant and no bond or reaction shall occur between the rod and the sealant.
- C. Hot Poured Elastic Joint Sealer: The sealant shall conform to the requirements of ASTM D3405. The manufacturer shall furnish a certificate of compliance for the material.
- D. Low Modulus Silicone Sealant: Low modulus silicone sealant shall be furnished in a one-part silicone formulation. The sealant must meet the following requirements:

TEST	LIMIT	TEST METHOD
Tack Free Time	20-75 minutes	MIL S 8802
Specific Gravity	1.010-1.515	ASTM D792 (Method A)
Durometer Hardness Type A: [Cured 7 days at 77°F ±3° (25° C ±2°) and 45% to 55% R.H.]	10-25 0°F (-18° C)	ASTM D2240
Tensile Stress: [at 150% elongation, 7 day (Die C) cure at 77° F ±3° (25°C ±2°) and 45-55% R.H.]	45-psi (310 kPa) max.	ASTM D412
Elongation: [7 day cure at 77° F ±3° □ (25° C (Die C) ±2°) & 45-55 R.H.]	1000% min.	ASTM D412
Shelf Life	6 month minimum from date of manufacture	
Ozone & Ultra Violet Resistance	No chalking, cracking or bond loss after 5000 hrs.	
Movement capability and adhesion [7 day cure in air 77° F ±3° (25° C ±2°)]	No adhesive or cohesive failure, * all 3 specimens must exceed 500% extension at 0° F (-18° C)	
Bond to Concrete Mortar Concrete briquettes [air cured 7 days at 77°F ±3° □ (25° C ±2°)]	50 psi (345 kPa) min. 0° F (-18°C)	AASHTO T132**

* Prepare the specimens using 1" x 2" x 3" (25 mm x 50 mm x 75 mm) concrete blocks made in accordance with ASTM D3407. A sawed face shall be used for bond surface. Seal two inches (50 mm) of block leaving ½ inch (13 mm) on each end of specimen unsealed. The depth of sealant shall be 3/8-inch (10 mm) and the width ½-inch (13 mm). Subject the sealant to movement at a rate of two inches (50 mm) per minute until failure.

** Briquettes molded in accordance with AASHTO T132 sawed in half and bonded with approximately 10 mils (0.25 mm) of sealant and tested using clips meeting AASHTO T132. Briquettes shall be dried to constant weight in oven 100□C ±5□. They shall be tested in tension at a loading rate of 0.3 inches (7.6 mm) per minute.

PART 3 EXECUTION

3.01 CONSTRUCTION JOINTS

- A. Place construction joints only where shown. In case of a breakdown in concrete placement, form the resulting unscheduled joint in the same orientation as the joints shown on the drawings for similar portions of the structure and include the key, waterstop, and additional reinforcing as may be required for the design function of the structure.
- B. After the concrete has hardened on one side of a construction joint and before placing the next concrete pour, remove the surface laitance and clean exposed surface by dry sandblasting. The sand blasted, roughened joint shall leave sound, exposed aggregate with a surface roughness of 0.2-inch \pm 0.1-inch. Just prior to placing the new concrete, coat the horizontal construction joint with a 2-inch layer of cement mortar and spread uniformly and work into all irregularities of the surface. Use cement mortar of the same mixture as the structural concrete but with the coarse aggregate omitted. The mortar shall not exceed the water-cement ratio of the concrete to be placed on it and the consistency shall be suitable for placing and working. Wet the vertical surface to be joined at a construction joint and use additional spading and vibrating to prevent voids.
- C. Key construction joints unless otherwise shown. Form keyways with beveled strips or boards placed at right angles to the direction of shear. Make keyways at least 1.5 inch in depth over at least 25% of the area of the section. When necessary to make a joint because of a breakdown or emergency, place reinforcing dowels across the joint. Embed dowels 40 bar diameters on each side of the joint. Match reinforcing in size and number.
- D. Provide isolation joints in slabs on ground at all points of contact between slabs on ground and vertical surfaces such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

3.02 JOINTS WITH JOINT SEALANT

- A. On structures or surfaces, which require joint sealant, do not remove the material for forming the groove in the concrete until the concrete is cured. Upon removing the groove form, sandblast the groove, allow it to dry, then place the primer, backup rod, and sealant into the clean groove in accordance with the manufacturer's recommendations. Prior to sealant application, the manufacturer's representative shall demonstrate joint preparation, priming, and sealant materials for the personnel performing joint work. Groove form material shall be installed prior to concrete placement.
- B. Place construction joints perpendicular to the main reinforcement. Continue all reinforcement across construction joints. Construction joints in water holding structures shall be provided with a half inch beveled notch on the inside surface provided for caulking the joints.

3.03 CONCRETE PAVEMENT JOINTS

- A. Immediately after sawing the joints to their final configuration, the resulting slurry shall be completely removed from the joint and the immediate area by flushing with a jet of water and other tools as necessary. Curing membrane damaged or protective cover removed during the sawing operation shall be repaired or replaced by the Contractor as directed by the Engineer at no cost to the Owner.
- B. Longitudinal Sawed Joints: Deformed steel tie bars shall be placed perpendicular to the longitudinal joints by approved methods. Tie bars shall not be painted or coated with asphalt or other material, or enclosed in tubes or sleeves. Longitudinal sawed joints shall be cut to the dimensions specified. Suitable guidelines or devices shall be used to assure cutting the joint to a true line. The joint shall be cured a minimum of 24 hours before sawing. The sawed joint will not require reapplication of curing compound. The joint shall be sealed as required in Section 03 15 00.
- C. Longitudinal Construction Joints: When adjacent lanes of pavement are constructed separately, a keyway shall be formed along the construction joint. When deformed steel tie bars are required, they may be bent at right angles for the first lane constructed and straightened into final position before the concrete of the adjacent lane is placed. Tie bars shall conform to Section 03 15 00, except that rail

steel shall not be used for tie bars that are to be bent and restrengthened. The longitudinal construction joint shall be sawed shortly after the end of the curing period and shall be sealed as required in Section 03 15 00.

- D. Transverse Contraction Joints: Transverse contraction joints shall be created by sawing. Sawing shall commence when the concrete has hardened sufficiently to permit sawing without raveling. Joints shall be sawed before uncontrolled shrinkage cracking takes place. If necessary, the sawing operations shall be carried on both day and night, regardless of weather conditions. The sawed joint will not require reapplication of curing compound.
- E. The sawing of a joint shall be omitted if a crack occurs at or near the joint location prior to the time of sawing. Sawing shall be discontinued when a crack develops ahead of the saw. Any procedure which results in premature and uncontrolled cracking shall be revised immediately by adjusting the sequence of cutting the joints or the time interval involved between the placing of the concrete or removal of curing media and the cutting of joints.
- F. Repair or correction of uncontrolled cracks shall be as directed by the Engineer and at the expense of the Contractor.
- G. Longitudinal random cracks penetrating the full depth of the pavement shall be grooved and sealed. The top of the crack shall be grooved to a minimum depth of $\frac{3}{4}$ inch (20 mm) and to a width of not less than $\frac{3}{8}$ inch (10 mm) nor more than $\frac{5}{8}$ inch (16 mm) by means of a router. The router shall be capable of following the path of the crack and widening the top of the crack to the required dimensions without spalling or damaging the concrete. Loose and fractured concrete shall be removed and the groove shall be thoroughly cleaned and sealed.
- H. For PCC Pavement with no load transfer across the contraction joint (dowel bar assemblies are not required), the following shall apply:
 - 1. When a transverse random crack terminates in or crosses a transverse contraction joint, the uncracked portion of the joint shall be filled with epoxy-resin mortar and the crack shall be routed and sealed in accordance with Section 03 15 00.
 - 2. Where a transverse random crack parallels the planned contraction joint and is within a distance of five feet (1.5 meters) from the contraction joint in the pavement, the crack shall be routed and sealed in accordance with Section 03 15 00, and the joint shall be filled with epoxy resin mortar.
 - 3. When a transverse random crack is more than five feet (1.5 meters) from the nearest contraction joint in the pavement, the joint and the crack shall be sealed in accordance with Section 03 15 00. Joints to be filled with epoxy resin mortar shall be thoroughly cleaned.
- I. For PCC Pavement with load transfer across the contraction joint (dowel bar assemblies are required), the following shall apply:
 - 1. When a transverse random crack parallels the planned contraction joint and is more than five feet (1.5 meters) from the contraction joint, the crack shall be routed, the backer rod installed, and sealed with silicone according to Section 03 15 00.
 - 2. When a transverse random crack parallels the planned contraction joint and is less than five feet (1.5 meters) from the contraction joint, the pavement shall be sawed full depth, removed, and replaced. Load transfer across the contraction joint shall be re-established.
 - 3. When a transverse random crack intersects or parallels a planned transverse contraction joint and is less than four inches (100 mm) from the planned contraction joint for more than 50 percent of the lane width, the crack shall be routed, the backer rod installed, and sealed with silicone in accordance with Section 03 15 00.
 - 4. When a transverse random crack intersects or parallels a planned transverse contraction joint and is more than four inches (100 mm) from the planned contraction joint for more than 50 percent of the lane width, the pavement shall be sawed full depth, removed, and replaced. Load transfer across the contraction joint shall be re-established.

3.04 SEALING CONCRETE PAVEMENT

- A. Joints shall be sealed with hot-poured elastic joint sealer or low modulus silicone sealant as specified. Joints shall be sealed immediately after completion of the curing period, before the pavement is opened to traffic.
- B. Joint grooves with spalls greater than ½ inch (13 mm) in depth shall be patched with an approved epoxy mortar. All loose concrete shall be removed from the spalled area and the spalled surface shall be thoroughly cleaned. After cleaning, the spalled surface shall be primed and an epoxy mortar of troweling consistency shall be placed in the spalled area and finished as the original pavement surface. The epoxy binder components shall be proportioned and mixed as recommended by the manufacturer. After the epoxy binder is thoroughly mixed, dry silica sand shall be blended into the mixture to give an epoxy mortar of trowelable consistency.
- C. After the epoxy mortar has cured, the forming material shall be carefully removed. The finished joint shall have vertical faces and the joint width shall be maintained. Patching of spalls shall be done only when the temperature of the air and pavement are above 50EF (10EC).
- D. Joints to be sealed shall be thoroughly clean and dry. All materials such as old sealant, oil, asphalt, curing compound, paint, rust, and other foreign materials shall be completely removed. Cleaning shall be accomplished by sand blasting and other tools as necessary.
- E. Just prior to sealing, each joint shall be blown out using a jet of compressed air, at a working pressure of not less than 90 psi (620 kPa), to remove all traces of dust. Air compressors used for cleaning joints shall be equipped with traps capable of removing all free water and oil from the compressed air.
- F. Joint sealer application will not be permitted when the air or pavement temperature near the joint is less than 40EF (5EC) or is 40EF (5EC) and falling.
- G. The sealant shall be applied without spilling on the exposed surface. Sealant on the surface of the concrete pavement shall be removed immediately and the pavement surface cleaned. Failure of the joint material in either adhesion or cohesion will be cause for rejection. Repair shall be at the expense of the Contractor.
- H. Hot-Poured Elastic Joint Sealer: Hot-poured elastic joint sealer shall be stirred during heating so that localized overheating does not occur. All joints shall be sealed with an approved pressure-sealing device, equipped with a nozzle inserted into the joint, so sealing material will be forced from the bottom of the joint to the top.
- I. Silicone Sealant: Silicone sealant shall be applied with a mechanical device equipped with a nozzle or spout shaped to fit into the joint. The joint sealant shall be applied under pressure from the inside of the joint to remove entrapped air and ensure good joint contact.
 - 1. Backer rod shall be installed to the proper depth to produce the width and depth of sealant specified.
 - 2. The sealant surface shall be tooled to produce a slightly concave surface ¼-inch (6 mm) below the pavement surface. Tooling shall be accomplished before a skin forms on the sealant surface. The use of soap or oil as a tooling aid will not be permitted.
- J. Seasonal Restrictions:
 - 1. Silicone sealing operations shall be suspended after October 15, unless the Contractor has received written permission from the Engineer to continue sealing. After the October 15 seasonal restriction, only the initial cut shall be performed at all joints. Then the following spring the joints shall be widened, backer rod installed, and sealed with silicone according to Section 03 15 00.
 - 2. All costs related to the seasonal sealing restrictions including additional labor and materials, equipment, traffic control, mobilization, and incidentals shall be at the expense of the Contractor.

3.05 WATERSTOP

- A. Install waterstops at construction and expansion joints in structures, which will contain liquid or resist the entry of ground water. Construct forms to prevent injury to waterstops. Position and secure with wire ties, continuous bars, and rings. Heat weld splices and junctions of waterstop to form a

continuous water seal. Use the heat welding equipment and temperature recommended by the waterstop manufacturer.

* * * END OF SECTION * * *

SECTION 03 20 00 CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the contract, including general and Supplementary Conditions, apply to the work specified in this section.

1.02 DESCRIPTION OF WORK

- A. The extent of concrete reinforcement is shown on the drawings and in schedules.
- B. The work includes fabrication and placement of reinforcement for cast-in-place concrete, including bars, welded wire fabric, ties, and supports.

1.03 QUALITY ASSURANCE

- A. Examine the substrate and the conditions under which concrete reinforcement is to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected.
- B. Codes and Standards: Comply with requirements of the following codes and standards, except as herein modified.
 - 1. American Concrete Institute, ACI 315 "Manual of Standard Practice for Detailing Reinforced Concrete Structures."
 - 2. American Concrete Institute, ACI 318, "Building Code Requirements for Reinforced Concrete."
 - 3. American Welding Society, AWS D12.1 "Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction."
 - 4. Concrete Reinforcing Steel Institute, "Manual of Standard Practice."

1.04 SUBMITTALS

- A. For information only, submit 2 copies of steel producer's mill test certificates identifying chemical and physical analysis of each type of reinforcing steel delivered.
- B. Submit shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with the ACI 315 "Manual of Standard Practice for Detailing Concrete Structures," show bar schedules, stirrup spacing, diagrams of bent bars, arrangements and assemblies, as required for the fabrication and placement of concrete reinforcement. Include special reinforcement required at openings through concrete structures.

1.05 PRODUCT DELIVERY, HANDLING, AND STORAGE

- A. Deliver reinforcement to the project site bundled, tagged, and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.
- B. Store concrete reinforcement materials at the site to prevent damage and accumulation of dirt or excessive rust.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Reinforcing Bars shall conform to ASTM A615, Grade 60, except as otherwise indicated.
- B. Steel Wire shall be plain wire conforming to ASTM A82.
- C. Welded Wire Fabric shall be of the gauge and mesh size as shown conforming to ASTM A185.
- D. Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement in place shall be as follows:

1. For bar supports, use CRSI Class C, plastic protected or Class E, stainless steel protected.
2. For slabs on grade, use supports with sand plates or horizontal runners where wetted base materials will not support chair legs.
3. Over waterproof membranes, use precast concrete chairs to prevent penetration of the membrane.

2.02 FABRICATION

- A. Shop-fabricate reinforcing bars to conform to required shapes and dimensions, with fabrication tolerances complying with ACI 315. In case of fabricating errors, do not re-bend or straighten reinforcement in a manner that will injure or weaken the material.
- B. Unacceptable Materials shall be defined as reinforcement with any of the following defects and will not be permitted in the work:
 1. Bar lengths, depths, and bends exceeding specified tolerances.
 2. Bends or kinks not indicated on drawings or on the final shop drawings.
 3. Bars with reduced cross section due to excessive rusting or other cause.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Unless shown otherwise on drawings, comply with the specified codes and standards, and Concrete Reinforcing Steel Institute recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports, and as herein specified.
- B. If the cover depth is not specifically indicated on the plan sheets, the reinforcing steel shall be protected by a minimum thickness of concrete as follows:
 1. Concrete against ground or exposed to water - 3" cover
 2. Concrete exposed to weather - 2" cover
 3. Beams and columns - 1 ½ " cover
 4. Slabs on grade or exposed to weather - 1" cover
- C. Clean reinforcement to remove loose rust and mill scale, earth, ice and other materials, which reduce or destroy bond with concrete.
- D. Position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.
- E. Unless shown otherwise on drawings, place reinforcement to obtain the minimum coverage for concrete protection. Arrange, space, and securely tie bars and bar supports together with 16-gage wire to hold reinforcement accurately in position during concrete placement operations. Set wire ties so that ends are directed away from exposed concrete surfaces.
- F. Install welded wire fabric in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with 16-gage wire. Do not make end laps midway between supporting beams, or directly over beams of continuous structures. Offset end laps in adjacent widths to prevent continuous laps.
- G. Provide sufficient numbers of supports and of strength to carry reinforcement. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

- H. Splices: Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying. Comply with requirements of ACI 318 for minimum lap of spliced bars except as shown on drawings.

*** END OF SECTION ***

SECTION 03 30 00 CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work of this section.
- B. Related Work Specified Elsewhere:
 - 1. Concrete Formwork, Section 03 11 00
 - 2. Concrete Reinforcement, Section 03 20 00

1.02 DESCRIPTION OF WORK

- A. The extent of cast-in-place concrete work is shown on the drawings.
- B. The work includes providing cast-in-place concrete consisting of Portland cement, fine and coarse aggregate, water and selected admixtures; combined, mixed, transported, placed, finished and cured as herein specified.

1.03 QUALITY CONTROL AND TESTING

- A. Prior to any concrete work, the Contractor shall obtain from his concrete supplier a certificate stating the design mix used by the supplier will meet or exceed the requirements of the specifications for Class A concrete as herein specified.
- B. The Contractor is responsible for controlling the quality of his product and shall make as many tests as necessary to satisfy himself and the Owner that his product meets or exceeds all specifications contained herein. The Contractor shall employ an independent professional testing laboratory experienced in the testing of concrete materials and mixes to perform material evaluation tests and to test concrete test cylinders. The testing agency shall meet the requirements of ASTM 329. The selection of the testing laboratory shall be subject to the Owner's and Engineer's acceptance. All such tests shall be at the expense of the Contractor.
- C. In addition to the Contractor quality control, the Engineer will perform temperature, slump, air, and compressive strength testing for the determination of product acceptance. The Engineer will cast a set of 4 standard 6-inch diameter cylinders for each 10 to 50 cubic yards of concrete placed or portion thereof and care for them as set forth in ASTM C31. These specimens shall be used to determine compressive strength requirements of the product. The results of these tests shall not relieve the Contractor of his responsibility to meet specifications contained herein.
- D. The right is reserved by the Owner to order additional checking of concrete strength by use of a Swiss hammer or by boring. Testing of this nature shall be done in the presence of the Engineer at the expense of the Contractor and may be submitted to an independent testing laboratory mutually agreed upon by the Contractor, Engineer, and Owner.

1.04 SUBMITTALS

- A. The certificate from the concrete supplier as specified above shall be submitted to the Engineer.
- B. The results of all concrete cylinder tests made shall be submitted to the Engineer.
- C. Copies of the delivery tickets for each load of concrete delivered to the site shall be furnished to the Engineer at the time of delivery.

PART 2 PRODUCTS

2.01 CONCRETE MATERIALS

- A. Water shall be clean and free of deleterious amounts of oils, acids, alkali, organics, silt, mud, grass, or other foreign material.
- B. Portland cement used shall meet the requirements of ASTM C150, Type II, for all usages. Only one brand of cement shall be used throughout the project unless otherwise accepted by the Engineer.
- C. Fly ash shall conform to AASHTO M 295 Class F including the optional requirements in the referenced AASHTO specification except as modified by the following:
 - Loss on ignition 2.0% Max.
 - Moisture content 2.0% Max.
 - Available alkalis as Na₂O 1.5% Max. *

* Available alkalis up to 2.0 percent may be used, provided mortar expansion test results at 14 days is less than or equal to that of the control sample. The expansion test shall be run in accordance with modified ASTM C 441. The control sample shall be made using cement that will be used on the project. The test sample shall be made using cement and fly ash that will be used on the project.
- D. Fly ash shall be from approved base loaded electric generating plants using a single coal source. Plants using a limestone injection process for controlling air pollutants are not acceptable. Fly ash from the start up and shut down of the plant shall not be used.
- E. Fine aggregate shall be clean, sharp, natural, uncoated sand free from silt, loam, and clay, dune sand, bank run sand and manufactured sand are not acceptable. Fine aggregate shall conform to ASTM C33, fine aggregate sections.
- F. Coarse aggregate shall be clean, uncoated crushed stone or gravel conforming to ASTM C33. Clay and shale particles shall not exceed 1%. Maximum size aggregate allowed is 1/5 of narrowest dimensions between forms of the concrete member or 3/4 of minimum clear spacing between reinforcing bars. For cement finish use 1/8 inch minimum and 3/8-inch maximum size aggregate.
- G. Aggregates containing soluble salts or other substances such as iron sulphides, pyrite, marcasite, or ochre, which can cause strains on exposed surfaces, will not be allowed.
- H. If noted on the plans, fiber mesh reinforcing shall be used with all concrete sidewalk and pavement. The fiber mesh shall be added at the rate of 1 bag per cubic yard or as otherwise recommended by the manufacturer. The fiber shall be added directly to the truck at the time of mixing.

2.02 CONCRETE ADMIXTURES

- A. Provide admixtures produced by established reputable manufacturers and use in compliance with the manufacturer's printed directions. Do not use admixtures, which have not been incorporated and tested in the accepted mixes unless otherwise authorized in writing by the Engineer. All admixtures shall meet standards as specified herein.
- B. Air-entraining Admixtures shall conform to ASTM C260 and shall be equal to Grace "Darex AEA," Master Builders "MB-VR"; or Sika Chemicals "AER."
- C. Calcium Chloride: Do not use calcium chloride in concrete unless otherwise authorized in writing by the Engineer.

2.03 CONCRETE CLASS

A. Classes of concrete:

CLASS OF CONCRETE	REQ. MIN. STRENGTH @ 28 DAYS (PSI)	MAX. WATER CONTENT GAL./94 LB. BAG
A	4,000	6.0

1. Class A concrete shall be used for all cast-in-place concrete. Minimum cement content for Class A concrete shall be 564 lbs. It may be used for all concrete requirements.

B. Grout and Topping:

1. Plain grout for channel bottoms; tank bottoms where required shall be proportioned as follows:

CONSTITUENT	BY VOLUME
Type II Portland Cement	1 Part
Sand	2 Parts
¼ " Aggregate	1 ½ Parts

2. Non-shrinking grout shall be Embecco, Pour-Rok, or approved equal.

2.04 CONSISTENCY

A. Consistency required for each pour shall be established in advance by the Contractor in cooperation with the Engineer in accordance with ASTM C143 and according to the following slump ranges:

TYPE OF CONSTRUCTION	SLUMP	AIR
Sidewalk	1" - 4 ½"	5% - 7.5%
Curb & Gutter	1" - 4 ½"	5% - 7.5%
Pavement (Formed)	1" - 4 ½"	5% - 7.5%
Pavement (Slipformed)	≤ 2"	5% - 7.5%
Miscellaneous	1" - 4 ½"	5% - 7.5%

B. Concrete shall be of consistency as to insure the required workability and result in compacted masses having dense, uniform surfaces. In general, the consistency of concrete mixture shall be such that:

1. The mortar will cling to the coarse aggregate.
2. The aggregates will not segregate in the concrete.
3. The concrete when dropped directly from the discharge chute of the mixer will flatten out at the center of the pile, but the edges of the pile will stand and not flow.
4. The concrete and mortar will show no free water when removed from the mixer.
5. The concrete will slide and not flow into place when transported in metal chutes at an angle of 30 degrees with the horizontal.
6. The surface of the finished concrete will be free from a surface film of "laitance."

- C. Any concrete mix failing to meet the above outlined consistency requirements, although meeting the slump requirements, will be considered unsatisfactory; and the mix shall be changed to correct such unsatisfactory conditions.

2.05 PROPORTIONING OF MATERIALS

- A. The proper proportioning of aggregates and cement will be determined by the Contractor and the professional testing laboratory. The proportioning of aggregates will be the most suitable combination of aggregates, which will give the necessary workability and desired consistency when mixed with water and cement as specified.
- B. The ratio of cement to dry, fine aggregate shall be that necessary to provide the maximum density of the mixture when used with the minimum amount of water required to produce the specified slump in the resulting concrete. This determination of the proper ratio shall be made by a testing laboratory at the expense of the Contractor, using representative samples of the aggregates, which will be used. Laboratory recommendations shall be submitted to the Engineer.
- C. The batch proportions used shall be such that full bags of cement are used in each batch.
- D. Fly ash may be substituted for cement in concrete. The addition or deletion of fly ash from the mix will be at no cost to the Owner. If fly ash is used, the minimum amount of cement to be replaced is 15 percent and the maximum amount is 20 percent by weight.

2.06 EXPANSION JOINT MATERIAL

- A. Expansion joint material shall be pre-molded, non-extruding asphalt impregnated joint filler conforming to ASTM D1751 unless shown otherwise on the plans. Joint material shall be full depth of slab or joint and unless otherwise indicated ½-inch thick.

2.07 FIBER REINFORCEMENT

- A. Synthetic Fiber Reinforcement.
 - 1. Material: 100 percent virgin homopolymer polypropylene multifilament fibers, containing no reprocessed olefin materials.
 - 2. Conformance: ASTM C 1116, Type III.
 - 3. Fire Classifications:
 - a. UL Report File No. R8534-11.
 - b. Southwest Certification Services (SWCS), Omega Point Laboratories No. 8662-1.
 - 4. Fiber Length: Single-cut lengths.
 - 5. Alkali Resistance: Alkali proof.
 - 6. Absorption: Nil.
 - 7. Specific Gravity: 0.91.
 - 8. Melt Point: 324 degrees F (162 degrees C).

PART 3 EXECUTION

3.01 STORAGE OF MATERIALS

- A. Cement shall be stored in well ventilated, weatherproof buildings, which will protect the cement from dampness. The floor supporting the cement shall clear the ground a sufficient distance to prevent the absorption of moisture by the cement. The Engineer may permit small quantities of cement to be stored in the open for short periods of time (maximum of 48 hours) if a raised storage platform and adequate waterproof covering are provided. Lumpy or partially set cement shall not be used, and such cement shall be removed from the premises.

- B. The handling and storage of concrete aggregate shall be such as to prevent the admixture of foreign materials. If the aggregates are stored on the ground, sites for stockpiles shall be grubbed, cleared of all weeds and grass and leveled off. The bottom layer of aggregate shall not be disturbed or used without cleaning. Unless otherwise authorized by the Engineer, all fine aggregate shall be stockpiled at least 24 hours to reduce the free moisture content.

3.02 MIXING CONDITIONS

- A. The concrete shall be mixed in quantities required for immediate use, and any concrete, which is not in place within 30 minutes after being discharged from the mixer, shall not be used. Retempering of concrete will not be permitted.
- B. Where work has been started and changes in weather conditions require protective measures to be used, the Contractor shall furnish adequate shelter to protect the concrete against damage from rainfall or damage due to freezing temperatures. In case it is necessary to continue mixing operations during rainfall, the Contractor shall provide protective coverings for the material stockpiles as well as for the concrete being placed. The covering for aggregate stockpiles will be required only to the extent as may be necessary to control the moisture conditions in the aggregates so that adequate control of the consistency of the concrete mix may be maintained.
- C. No concrete shall be mixed without the approval of the Engineer when the air temperature is at or below 40° F (taken in the shade away from artificial heat) and falling. If authorized by the Engineer, concrete may be mixed when the air temperature is at 35° F and rising. When permission is given for mixing when the temperature is below 40° F, the following requirements shall govern:
 - 1. Water used for mixing shall be heated either by steam or by dry heat to a temperature of at least 70° F but not over 150° F.
 - 2. Aggregates shall be heated either by steam or by dry heat to a temperature of at least 70° F but not over 150° F.
 - 3. The heating apparatus shall be such as to heat the mass of aggregates uniformly and preclude the occurrence of hot spots, which will burn the material. Temperature of mixed concrete shall be not less than 60° F at the time of placing in forms. After the concrete has been placed, the Contractor shall provide sufficient protection such as cover, canvas, framework, heating apparatus, etc., to enclose and protect the structure and maintain the temperature of the mix at not less than 50° F until at least 60% of the designed strength has been attained.
 - 4. The use of an accelerating agent in lieu of proper cold weather protection will not be authorized. In hot weather suitable precautions shall be taken to avoid drying of the concrete prior to finishing operations. Use of windbreaks, sunshades, fog sprays, or other devices shall be provided.
 - 5. Concrete deposited in hot weather shall not have a placing temperature that will cause difficulty from loss of slump, flash set, or cold joints. Concrete temperatures shall be less than 90° F.

3.03 CONCRETE PLACEMENT

- A. Before placing concrete, the Contractor shall see that bottoms of excavations are undisturbed earth, properly leveled off and tamped free of foreign materials. Forms shall be oiled or wetted prior to placing concrete. Water shall be removed from the excavation before any concrete is deposited.
- B. The concrete shall be placed in the structure immediately after mixing. Concrete shall be placed in continuous horizontal layers approximately 12-inch in thickness. Not more than 1 hour shall elapse between the placing of successive layers of concrete in any portion of the structure included in a monolithic placement. Special care must be used to thoroughly surround all reinforcement with concrete and to leave no air space or other void in this work. All concrete shall be well vibrated into all areas of forms.
- C. No concrete shall be used after its initial set has taken place, and no retempered concrete will be allowed under any circumstances or conditions.

- D. Concrete handling from the point of delivery and transfer to the concrete conveying equipment and to the locations of final deposit shall be completed as rapidly as practicable by methods which will prevent segregation and loss of concrete mix materials.
- E. Mechanical equipment for conveying concrete shall be provided to ensure a continuous flow of concrete at the delivery end. Provide runways for wheeled concrete conveying equipment from the concrete delivery point to the locations of final deposit. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete, debris, water, snow, ice, and other deleterious materials.

3.04 CONSTRUCTION JOINTS

- A. Construction joints shall be made at the locations indicated on the plans or at such other locations as designated by the Engineer. In no case shall vertical joints be made in walls at or near corners. Proper bonding shall be obtained in accordance with the above specifications and the CRSI.
- B. Keys shall be provided in all joints where required to provide for either shear or water tightness. The width of the keys shall be approximately $\frac{1}{2}$ the thickness of the section at that point, and they shall be $\frac{1}{2}$ as deep as they are wide unless otherwise specified.
- C. All concrete shall be deposited in forms at such rate that the forms will be filled at any point with a vertical rise of concrete surface of not less than 2 feet per hour. Where necessary, the forms shall be bulk headed off and construction joint made to provide a form, which will be filled at the above specified rate. The location of these construction joints shall be approved by the Engineer.
- D. If any concrete is allowed to stand at any elevation below the finished grade or top surface for more than 2 hours without fresh concrete being applied thereon, the top surface shall be considered a construction joint and shall be constructed in accordance with these specifications and provided with keys and water sealing strips.
- E. Where practicable, vertical construction joints shall make a slight angle with the vertical, not to exceed $\frac{1}{2}$ -inch per foot, in such manner that the freshly deposited concrete will overhang the hardened concrete, allowing the new concrete to settle upon the old during the process of hardening.

3.05 PROTECTING AND CURING

- A. All concrete, regardless of temperature, weather, or season, shall be protected from premature drying. Surface cracking shall be a cause for rejection, removal, and replacement. Any concrete poured during freezing or hot weather conditions shall be protected. No salts or other non-freezing materials shall be used. All fresh concrete shall be protected from open rain. All concrete shall be kept damp for at least 6 days after pouring. Membrane curing may be used. Membrane curing compound if used shall be a resin base type approved by the Engineer. Curing will not be required longer than 72 hours if high early strength concrete is used.

3.06 FINISH OF FORMED SURFACES

- A. Rough Form Finish:
 - 1. Provide as-cast rough form finish to formed concrete surfaces that are to be concealed in the finish work or by other construction unless otherwise indicated.
 - 2. Standard rough form finish shall be the concrete surface having the texture imparted by the form facing material used with tie holes and defective areas repaired and patched and all fins and other projections exceed $\frac{1}{4}$ -inch in height rubbed down or chipped off.
- B. Smooth Form Finish:
 - 1. Provide as-cast smooth form finish for formed concrete surfaces that are to be exposed to view or that are to be covered with a coating material applied directly to the concrete, or a covering material bonded to the concrete such as waterproofing, damp-proofing, painting or other similar system.

2. Produced smooth form finish by selecting form material to impart a smooth, hard, uniform texture and arranging them orderly and symmetrical with a minimum of seams. Repair and patch defective areas with all fins or other projections completely removed and smoothed.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off, smooth, and finish with a texture matching the adjacent formed surfaces. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surfaces unless otherwise shown.

3.07 MONOLITHIC SLAB FINISHES

A. Float Finish:

1. Apply float finish to monolithic slab surfaces that are to receive trowel finish and other finishes as hereinafter specified.
2. After placing concrete slabs do not work the surface further until ready for floating. Begin floating when the surface water has disappeared or when the concrete has stiffened sufficiently to permit the operation of a power-driven float or both. Consolidate the surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Check and level the surface plane to a tolerance not exceeding ¼-inch in 10 feet when tested with a 10-foot straightedge placed on the surface at not less than 2 different angles. Cut down high spots and fill all low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat the surface to a uniform, smooth granular texture.

B. Trowel Finish:

1. Apply trowel finish to monolithic slab surfaces that are to be exposed to view unless otherwise shown and slab surfaces that are to be covered with epoxy terrazzo, resilient flooring, paint, or other thin-film finish coating system.
2. After floating, begin the first trowel finish operation using a power-driven trowel if desired.
3. Consolidate the concrete surface by the final hand troweling operation, free of trowel marks, uniform in texture and appearance and with a surface plane tolerance not exceeding 1/8-inch in 10 feet when tested with a 10-foot straightedge. Grind smooth surface defects, which would telegraph through applied floor covering system.

C. Non-slip Broom Finish:

1. Apply non-slip broom finish to exterior and interior concrete platforms and bridges, steps, walks and ramps and elsewhere as shown on the drawings or in schedules.
2. Immediately after trowel finishing slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route. Coordinate the required final finish with the Engineer before application.

D. Exposed Aggregate Finish:

1. The Contractor shall construct an exposed aggregate sample thirty-six (36) inches long by thirty-six (36) inches wide, and receive the Owner's approval, prior to any work involving this type of surfacing.
2. Following the Owner's acceptance of the exposed aggregate sample, and immediately after removal of form work, wash concrete surfaces with water and scrub with stiff bristle brush exposing aggregate to match accepted sample panel.
3. When desired finish is achieved, wash and rinse exposed aggregate surfaces with cleaning agent.

E. Carpet Drag Finish:

1. Before the concrete has attained its initial set, the surface shall be given a final finish with a carpet drag drawn over the surface in a longitudinal direction. The drag shall be mounted on a

bridge and shall be sized so that a strip of the carpet at approximately two feet (600 mm) wide is in contact with the pavement surface while the drag is operated.

2. The condition of the drag shall be maintained so the resultant surface is of uniform appearance with corrugations approximately 1/16 inch (2 mm) in depth. Drags shall be maintained clean and free of encrusted mortar. Drags that cannot be cleaned shall be discarded and replaced.
3. The carpet shall meet the following requirements:
 - a. Facing Material - Molded polyethylene pile face
 - b. Blade Length - 7/8", ±1/8" (22 mm, ±3 mm)
 - c. Total Fabric Weight - 70 oz. Per square yard min.
 - d. (2.37 kg per square meter min.)
4. The backing shall be of a strong, durable material, not subject to rot, which is adequately bonded to the facing.
5. Brooming may be used on irregular areas in lieu of the carpet drag and tine finish. The broom shall be drawn transversely across the pavement with adjacent strokes slightly overlapping.
6. Brooming shall be uniform in appearance and shall produce grooves 1/16 inch (2 mm) deep. Texturing shall be completed while the concrete surface can be broomed without being torn or unduly roughened by the operation.
7. The finished surface shall be free from rough and porous areas, irregularities, and depressions resulting from improper handling of the broom.

3.08 CONCRETE SURFACE REPAIRS

A. Patching Defective Areas:

1. Repair and patch defective areas with cement mortar immediately after the removal of the forms but only after the Engineer has inspected the defective area.
2. Cut out honeycomb, rock pockets, voids over ½-inch diameter and holes left by tie rods and bolts, down to solid concrete, but, in no case, to a depth of less than 1-inch. Make edges of cuts perpendicular to the concrete surface. Before placing the cement mortar, thoroughly clean, dampen with water, and brush coat the area to be patched with neat cement grout. Proprietary patching compounds may be used when acceptable to the Engineer.
3. For exposed-to-view surfaces blend white Portland cement and standard Portland cement so that when dry the patching mortar will match the color of the surrounding concrete. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with the patching. Compact mortar in place and strike off slightly higher than the surrounding surface.
4. Fill holes extending through concrete by means of a plunger type gun or other suitable device from the least exposed face, using a flush stop held at the exposed face to ensure complete filling.

B. Repair of Formed Surfaces:

1. Repair exposed-to-view formed concrete surfaces where possible that contain defects which adversely affect the appearance of the finish. Remove and replace the concrete having defective surfaces if the defects cannot be repaired to the satisfaction of the Engineer. Surface defects as such include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, and holes left by the rods and bolts; fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
2. Repair concealed formed concrete surfaces where possible that contain defects that adversely affect the durability of the concrete. If defects cannot be repaired, remove and replace the concrete having defective surfaces. Surface defects as such include cracks in excess of 0.01 in. wide, cracks of any width and other surface deficiencies which penetrate to the reinforcement or

completely through non-reinforced sections, honeycomb, rock pockets, holes left by tie rods and bolts and spalls except minor breakage at corner.

C. Repair of Unformed Surfaces:

1. Test unformed surfaces such as monolithic slabs for smoothness and to verify surface plane to the tolerances specified for each surface and finish. Correct low and high areas as herein specified.
2. Test unformed surfaces sloped to drain for trueness of slope in addition to smoothness, using a template having the required slope. Correct high and low areas as herein specified.
3. Repair finished unformed surfaces that contain defects, which adversely affect the durability of the concrete. Surface defects as such include crazing, cracks in excess of 0.01-inch wide or that penetrate to the reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.
4. Correct high areas in unformed surfaces by grinding after the concrete has cured sufficiently so that repairs can be made without damage to adjacent areas.
5. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out the low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to the Engineer.
6. Repair defective areas except random cracks and single holes not exceeding 1-inch diameter by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least ¾-inch clearance all around. Dampen all concrete surface in contact with patching concrete and brush with a neat cement grout coating or use concrete bonding agent. Place concrete before grout takes its initial set. Mix patching concrete of the same materials to provide concrete of the same type of class as the original adjacent concrete. Place, compact, and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.
7. Repair isolated random cracks and single holes not over 1-inch in diameter by the dry-pack method. Groove the top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen all cleaned concrete surfaces and brush with neat cement grout coating. Place dry-pack before the cement grout takes its initial set. Mix dry-pack consisting of 1-part Portland cement to 2-½ parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patch areas continuously moist for not less than 72 hours.
8. Repair methods not specified above may be used subject to the acceptance of the Engineer.

3.09 SURFACE TEST AND TOLERANCES

- A. Ten Foot Straightedge: The concrete surface shall be tested with a 10-foot straightedge. The permissible longitudinal and transverse surface deviation shall be 1/8-inch in 10 feet.
- B. Areas where the maximum deviation exceeds the permissible deviation by not more than 3/8 inch will be subject to the following at the discretion of the Engineer.
 1. Grind down to an elevation where the area or spot will be within the permissible deviation.
 2. Accept affected area without corrective action with price reduction at a rate noted below.
- C. Areas where maximum deviation exceeds the permissible by more than 3/8 inch will be subject to the following at the discretion of the Engineer.
 1. Grind down to an elevation where the area or spot will be within the permissible deviation.
 2. Accept affected area without corrective action with price reduction at a rate noted below.
 3. Satisfactorily remove and replace deficient area.

- D. Grinding shall be accomplished with specially prepared circular diamond blades mounted on a horizontal shaft. Areas that have been ground shall not be left smooth or polished, but shall have a uniform texture equal in roughness to the surrounding unground concrete.
- E. Measurements for determining the limits of deficient areas will be made in the following manner:
 - 1. The length of the deviation will be that length out of specification tolerance at the location of the surface test as checked with a 10-foot straightedge and a 1/8-inch shim.
 - 2. Where the transverse surface test is out of specification, the maximum length and maximum width at a particular site shall be used in computation of the area.

3.10 DEFECTIVE WORK

- A. Concrete work, which does not conform to the specified requirements, including strength, tolerances, and finishes, shall be corrected at the Contractor's expense without extension of time therefore. The Contractor shall also be responsible for the cost of corrections to any other work affected by or resulting from corrections to the concrete work.

* * * END OF SECTION * * *

SECTION 31 23 00 EXCAVATION AND FILL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions and General Requirements, if attached, apply to the work specified in this section.
- B. Related Work Specified Elsewhere:
 - 1. Watering for Embankments - Section 31 23 11

1.02 DESCRIPTION OF WORK

- A. The Work covered by this section of the specifications shall consist of furnishing all plant, labor, and equipment, appurtenances and material, and of performing all operations in connection with the excavation, embankment, compaction, topsoiling, and grading required for the reconstruction of the City streets in accordance with these specifications and in conformity with the dimensions and typical sections shown on the plans and with the lines and grades established by the Engineer.
- B. The Owner's representative will provide the initial and final grade stakes as discussed in Section 01 32 23. The Contractor shall be responsible for providing all interim slope and grade staking and other staking as may be necessary to complete construction.

1.03 CLASSIFICATION OF EXCAVATION

- A. "Unclassified Excavation" shall include all excavation performed under this section regardless of the material encountered.

1.04 QUALITY ASSURANCE

- A. During the construction of the subgrade, a representative of the Owner shall be on site to allow for the examination of the exposed subgrade.
- B. In-place density tests will be taken, by the Owner's representative, on each layer of the subgrade as directed by the Geotechnical report.
- C. The Contractor will conduct additional soil tests and quality control testing as desired for his own information and use. The Contractor shall have submitted directly to the Engineer with copies to the Owner, three (3) copies of all field and laboratory tests and reports of inspections performed by him or his agents.
- D. All grades shall be finished to within 0.10 feet of the final elevations as staked by the Owner's authorized representative.

PART 2 PRODUCTS

2.01 CONTRACTOR FURNISHED BORROW (if required)

A. Borrow Material furnished by the Contractor shall be clean earthen fill material free from sticks, roots, stones larger than 3 inches and other deleterious material. **Prior to any hauling the Contractor shall furnish laboratory test results showing the classification of the borrow material by the Unified Soil Classification System (USCS), Liquid Limit, Plasticity Index and Standard Proctor w/ Max Density at Optimum Moisture.** The Borrow material shall meet the USCS requirements for the following soil classifications: (SC) Clayey Sands and (CL) Sandy Clays.

PART 3 EXECUTION

3.01 GENERAL

- A. The excavation shall be carried to the elevations or depths required to obtain the specified depths as shown on the plans. Should the Contractor, through negligence or other fault, excavate below the designated lines or elevations, he shall replace the excavation with suitable materials and properly compact and control the moisture content in a manner as specified herein under "Formation of Embankments". All replacement work shall be at the Contractor's expense.
- B. The Contractor shall inform and satisfy himself as to the character, quantity, and distribution of all material to be excavated. No payment will be made for any excavated material which is used for purposes other than those designated. All spoil areas shall be leveled to a uniform line and section and shall present a neat appearance before project acceptance.
- C. Those areas outside of the embankment areas in which the top layer of soil material becomes compacted due to hauling or to any other activity of the Contractor shall be scarified and disced to a depth of 4 inches as directed to loosen and pulverize the soil.
- D. If it is necessary to interrupt existing surface drainage, sewers, or under drainage, conduits, utilities, or similar underground structures, or parts thereof, the Contractor shall be responsible for and shall take all necessary precautions to protect and preserve or provide temporary service. When such facilities are encountered, the Contractor shall notify the Engineer. The Contractor, at his own expense, shall satisfactorily repair all damage to such facilities or structures which may result from any of his operations during the period of the contract.
- E. The Contractor shall supervise the excavation, moving, placing, and deposition of all material and shall, with the assistance of the Engineer and/or his representative, determine the suitability of materials to be placed in embankments. All material determined to be unsuitable and all excess shall be disposed of in the appropriate areas as shown on plans, or in the outer portions of the embankments.
- F. Topsoil shall not be used directly below any areas to receive surfacing.

3.02 STRIPPING

- A. All vegetation such as brush, heavy sods, heavy growth of grass, decayed vegetation, rubbish, roots, and any other unsuitable material within the area to which excavation is to occur, or upon which embankment is to be placed, shall be cleared, stripped, grubbed, and disposed of, before the excavation of suitable materials or a formation of embankment is started.
- B. In no case shall such objectionable material be allowed in or under the subgrades for any areas to receive surfacing.
- C. All depressions or holes below the ground surface, whether caused by grubbing or otherwise, shall be backfilled with suitable material and compacted to the ground surface elevation or up to twelve (12) inches below the proposed final subgrade elevation before the construction of the embankment will be permitted to start.

3.03 EXCAVATION OF SUITABLE MATERIAL

- A. Excavation shall be performed to the lines, grades, and elevations as indicated in the plans or as directed by the Engineer and shall be made so that the requirements for formation of embankments and floor can be followed. No excavation or stripping shall be started until the Engineer has taken cross sectional elevations and measurements of the existing ground surface and has provided control stakes for the proposed work. During the process of excavation, the grade shall be maintained so that it will be properly drained at all times. Temporary drains and drainage ditches shall be installed to intercept or divert all surface water which may affect the work.
- B. The suitable excavation material shall be handled in such a manner as to allow the material to be properly placed and compacted in the fill areas.
- C. The Contractor shall make the distribution of the excavated material as indicated in the plans. Widening or narrowing of the section and raising or lowering of the grade to avoid haul will not be permitted. The right is reserved by the Engineer to make minor adjustments or revisions in lines or grades if found necessary as the work progresses to obtain satisfactory construction.
- D. Stones or rock fragments larger than 4 inches in their greatest dimension will not be permitted in the top eight (8) inches of the subgrade or embankment.
- E. All cut-and-fill slopes shall be uniformly dressed to the slope, cross section, and alignment as shown in the plans.
- F. No payment or measurement for payment will be made for suitable materials removed, manipulated, and replaced in order to obtain required density. Any removal, manipulation, aeration, replacement, and recompaction of suitable materials necessary to obtain the required density shall be considered as incidental to the excavation and embankment operations and shall be performed by the Contractor at no additional compensation.

3.04 STOCKPILING

- A. If at the time of excavation it is not possible to place any material in its proper section of the permanent construction, it shall be stockpiled in approved areas for later use at no extra cost to the Owner.
- B. The stockpiled material shall be handled and placed as specified in the section of these specifications covering excavation, embankment, and topsoil.
- C. Stockpiles of topsoil or any other material shall be located within the project limits as near the final placement site as practicable. When stockpiling within the project limits is not possible, it shall be the Contractor's obligation to arrange for and maintain stockpile sites at his own expense. Stockpiles of topsoil shall not be placed within 50 feet of embankment areas and shall not be placed on areas which subsequently will require any excavation or embankment.
- D. Prior to Completion of the Work, the Contractor shall obtain and furnish to the Owner a lien waiver or a letter of satisfaction written by the owner of the stockpile area property and addressed to the Contractor.

3.05 EXCESS EXCAVATION

- A. When the volume of excavation exceeds that required to construct the embankments to the grades indicated, the excess shall be used to grade the areas of ultimate development or wasted in areas secured by the Contractor, subject to the approval of the Engineer and the Owner. In general, suitable excess excavation will be used in the widening of embankments, flattening of slopes, etc.
- B. If it is necessary to dispose of any material, it shall be disposed of in such a manner as to present a neat appearance and to not obstruct proper drainage or cause damage to abutting property.

3.06 PREPARATION OF EMBANKMENT AREA

- A. Prior to the placement of any fill material beneath the proposed trail, the entire layer of topsoil upon which the embankment is to be placed, except where limited by solid rock, shall be removed for its entire depth to the bottom of the natural existing topsoil.

- B. A minimum of six (6) inches of material below the bottom of the natural existing topsoil or to the depth as previously described shall be scarified for the entire width of the subgrade embankment. The area shall be scarified in furrows uniformly spaced so that at least 50% of the surface will be broken to the required depth. All roots, debris, large stones, or objectionable material that would cause interference with the compaction of the foundation for fill shall be removed from the area and disposed of as specified.
- C. After removal and scarifying of the topsoil and other material under the embankment areas, the area should be examined by the Contractor for the existence of unsuitable materials. The Contractor shall notify the Engineer if he feels that unsuitable materials exist. The volume of unsuitable material shall be determined by cross sectioning the area before and after removal. The area of unsuitable material shall be removed to a depth as shown in the plans or as directed by the Owner's representative. The area shall be filled and compacted in accordance with "Formation of Embankments".
- D. A thin layer (approximately 3 inches) of the fill material shall then be uniformly spread over the scarified foundation and the whole area compacted to ###% (see Geotechnical report) of maximum density as determined by standard proctor ASTM Test Designation D698 at a moisture content between 3% under and 3% over optimum.
- E. Except for the undercut of unsuitable materials which lie at a depth greater than six (6) inches below finished grade elevation in areas previously described, no direct payment shall be made for work performed under this section.

3.07 FORMATION OF EMBANKMENTS

- A. Embankments shall be formed of satisfactory materials placed in successive horizontal layers of not more than 8 inches loose depth for the full width of the cross section.
- B. The grading operations shall be conducted and the various soil strata shall be placed to produce a soil structure as shown in the typical cross section or as directed. All materials entering the embankment shall be reasonably free of organic matter such as leaves, grass, roots, and other objectionable material. Soil, granular material, shale, and any other material permitted for use in embankment shall be spread in successive layers as specified.
- C. The subgrade embankments shall be constructed from the in-place non-organic soils.
- D. Operations on earthwork shall be suspended at any time when satisfactory results cannot be obtained because of rain, freezing weather, or other unsatisfactory conditions of the field. The Contractor shall drag, blade, or slope the embankment to provide proper surface drainage. Frozen material shall not be placed in the embankment nor shall embankments be placed over frozen material.
- E. The material in the layers shall be of the proper moisture content before rolling to obtain the prescribed compaction. Wetting or drying of the material and manipulation when necessary to secure a uniform moisture content throughout the layer shall be required. Should the material be too wet to permit proper compaction or rolling, all work on all portions of the embankment thus affected shall be delayed until the material has dried to the required moisture content. Sprinkling shall be done in accordance with the requirements of Section 31 23 11. Samples of embankment materials for testing, both before and after placement and compaction, will be taken. From these tests, corrections, adjustments, and modifications of methods, materials, and moisture content will be made to construct the embankment.
- F. Where a large portion of the materials excavated consist of rock, the rock may be used in the construction of the embankment as hereinafter specified:
 1. The maximum dimension of any rock used shall not exceed 12" maximum.
 2. Rocks shall be carefully distributed throughout the embankment and imbedded with earth or other fine material so that the interstices between the large particles are filled and a dense, compact, uniform embankment is secured.
 3. No rock larger than 4" in any direction will be allowed in the upper eight (8) inches of any

embankment as this portion of the embankment shall be composed solely of earth or other suitable material.

- G. The Contractor shall be responsible for the stability of all embankments made under the contract and shall replace any portion which in the opinion of the Engineer has become displaced due to carelessness or negligence on the part of the Contractor. The Contractor shall plan his work so that the necessary compaction tests on each lift can be completed prior to placing additional lifts of material.

3.08 DIVERSION DITCHES AND DRAINAGE PROVISIONS

- A. If it is necessary, in the prosecution of the work, to interrupt the natural drainage of the surface, or the flow of artificial drain, the Contractor shall provide temporary drainage facilities that will prevent damage to public or private interests and shall restore the original drains as soon as the work will permit. The Contractor shall, at his own expense, take all measures necessary to properly drain the work site. The Contractor shall be held liable for all damages which may result from neglect to provide for either natural or artificial drainage which his work may have interrupted. All temporary diversion ditches shall be of adequate size to handle any anticipated flow.
- B. Diversion ditches which are to be permanent shall conform to the shape required in the plans.

3.09 TOPSOIL

- A. The topsoil shall be stripped and stockpiled from the regular grading areas and placed on all disturbed areas, at the conclusion of the project , as shown on plans.
- B. All topsoil removed from the excavation areas shall be salvaged (on areas to be grass, topsoil shall be replaced at conclusion of the project).
- C. The stockpiling of topsoil shall be in accordance with the requirements of paragraph 3.04.

3.10 TOLERANCES

- A. The subgrade and all other graded surfaces shall be of such smoothness that it will not vary more than 0.10 of a foot from true grade as established by grade hubs. Any deviation in excess of this amount shall be corrected by loosening, adding, or removing materials, reshaping, and compacting.

3.11 WATERING FOR EMBANKMENTS

- A. Refer to Section 31 23 11 - Watering for Embankments.

3.12 EQUIPMENT

- A. The Contractor may use any type of earthmoving, compaction, and watering equipment he may desire or has at his disposal, provided the equipment is in a satisfactory condition and is of such capacity that the construction schedule can be maintained as planned by the Contractor and as approved by the Owner in accordance with the completion schedule specified for the construction. The Contractor shall furnish, operate, and maintain such equipment as is necessary to control uniform density, layers, section, and smoothness of grade.

3.13 HAUL

- A. No payment will be made separately or directly for haul on any part of the Work. All hauling will be considered a necessary and incidental part of the Work, and its cost shall be considered by the Contractor and included in the contract price for the work involved.

PART 4 MEASUREMENT AND PAYMENT

4.01 METHOD OF MEASUREMENT

- A. In the event unsuitable material is encountered during subgrade construction, and the Contractor has requested in writing and received the Engineer's approval, measurement of the additional amount of excavation required, payment for excavation, removal and disposal of said unsuitable material shall be on a cubic yard basis at the contract unit price bid for unclassified excavation.

4.02 BASIS OF PAYMENT

- A. Payment for unsuitable material shall be on a cubic yard basis at the contract unit price bid for unclassified excavation.

*** END OF SECTION ***

SECTION 31 23 11 WATERING FOR EMBANKMENTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work of this section.
- B. Related Work Specified Elsewhere:
 - 1. Excavation and Fill - Section 31 23 00

1.02 DESCRIPTION OF WORK

- A. This item shall consist of furnishing and applying water required in the compaction of embankments and/or the clay cover, and for other purposes in accordance with the requirements of these specifications or as directed.

PART 2 PRODUCTS

2.01 WATER SOURCE

- A. The Contractor shall obtain a Temporary Water Rights Permit to use water for construction, testing, or drilling purposes from the ND Department of Environmental Quality for all water sources.
- B. The Contractor shall be responsible to provide own source of water for construction. Contractor shall obtain all federal, state, and local permits necessary for sources provided by Contractor. Upon receipt of the permits the Contractor shall submit two copies to the Engineer for his review and approval prior to removal of any water.
- C. The Contractor shall be responsible for all measures necessary to protect the health and safety of all personnel with access to the site.

PART 3 EXECUTION

3.01 CONSTRUCTION METHODS

- A. Water, when required, shall be applied at the locations, in the amounts, and during the hours, including nights, as required. An adequate water supply shall be provided by the Contractor.
- B. The equipment used for watering shall be of ample capacity and of such design as to assure uniform application of water in the amounts required.
- C. Contractor shall provide information to Engineer on size or capacity of water vehicle used and shall provide daily load counts to the Resident Project Representative.

*** END OF SECTION ***

SECTION 31 23 14 SHEETING, SHORING, AND BRACING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the contract, including General and Supplementary Conditions shall apply to work covered in this section.
- B. Related requirements specified elsewhere:
 - 1. Trenching, Backfilling and Compacting - Section 31 23 33
 - 2. Sanitary Sewer Piping and Fittings – Section 33 31 00

1.02 DESCRIPTION OF WORK

- A. Furnish and install all necessary sheeting, shoring, and bracing to adequately protect all new and existing structures, all existing piping as may be required during construction period, and all new piping.

PART 2 PRODUCTS

2.01 MATERIALS AND CONDITION

- A. All sheeting, shoring, and bracing shall be in good or new condition and shall conform to the requirements of current safety codes and guidelines.

PART 3 EXECUTION

3.01 METHODS

- A. All excavation shall be properly shored, sheeted, and braced to furnish safe working conditions conforming to the current codes, regulations, and guidelines; to prevent any shifting and movement of material which may endanger personnel; to prevent damage to structures, or other work; and to avoid delay to the work.
- B. Bracing shall be so arranged as not to place any strain on portions of completed work until the general construction has proceeded far enough to provide ample strength. If the Engineer is of the opinion that at any point the sheeting or supports furnished are inadequate or unsuited for the purpose, he may order additional sheeting or support to be installed. Whether so ordered by the Engineer or not, sufficient sheeting or support shall be installed to protect the work from any damage to new structures.
- C. Trench sheeting shall remain in place until pipe, etc., has been laid, tested for defects, and repaired if necessary, and the earth around it compacted to a depth of one foot over the top of the pipe. Timber sheeting if used shall not be removed below an elevation of two feet above the top of the pipe.
- D. No sheeting, shoring, and bracing which is within three feet of the surface of the finished grade may be left in place without the written permission of the Engineer.
- E. In general, the sheeting and bracing shall be removed as the excavation is refilled in such a manner as to avoid the caving in of the bank or disturbance to adjacent areas or structures. The voids left by the withdrawal of the sheeting shall be carefully filled by ramming or otherwise as directed. Permission of the Engineer shall be obtained before the removal of any shoring, sheeting, or bracing.
- F. It shall be the duty and responsibility of the Contractor to be familiar with all local, state, and federal regulations relating to this type of work and to comply with those regulations.

*** END OF SECTION ***

SECTION 31 23 33 TRENCHING, BACKFILLING, AND COMPACTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions shall apply to the work covered in this Section.
- B. Related Requirements specified elsewhere:
 - 1. Sheeting, Shoring and Bracing - Section 31 23 14
 - 2. Curbs, Gutters, Sidewalks and Driveways - Section 32 16 00
 - 3. Existing Underground Utilities - Section 33 01 00
 - 4. Sanitary Sewer Piping and Fittings – Section 33 31 00

1.02 SCOPE

- A. This section covers the excavation of all necessary trenching for underground utilities and backfilling same after the pipe and related material has been properly laid, inspected and tested all in accordance with applicable federal, state and local laws and regulations.

1.03 QUALITY ASSURANCE

- A. The Contractor shall obtain qualified testing and inspection services and such other independent services as may be required to assure compliance with the requirements as specified hereinafter. Certified tests of all granular materials will be provided to the Engineer prior to delivery or installation on the job site.
- B. Moisture-density (Proctor) tests on the engineered fill materials and all in-place engineered fill field density tests shall be made as herein specified and in accordance with the General Conditions. Sufficient tests in number and location will be performed so as to assure that the engineered fill is in general compliance with the compaction requirements as specified herein.
- C. The Contractor may conduct additional soil testing and quality control testing as desired for his own information and use.
- D. When requested by the Engineer or Resident Project Representative, the Contractor shall excavate and expose the pipe previously laid at any point.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL EXCAVATION

- A. All material encountered shall be excavated to the lines and grades as shown on the plans, set by the Engineer or as specified herein.
- B. Unless otherwise shown on the plans, trenches for forcemain shall be of a depth that will provide the following minimum covers over the top of the pipe as measured from the original ground surface.
 - 1. Minimum cover for all watermain and forcemain shall be seventy-two (72) inches.
- C. Where pipe elevation is determined by minimum depth only, the excavation shall be sufficient at all points to grade the pipes on the tangents and vertical curves as dictated by the minimum bending radius of the pipe and fittings as recommended by the manufacturers.
- D. The trenches shall be sufficiently straight between designated angle points to permit the pipe to be laid true to line in the approximate center of the trench.
- E. Intersections with and crossings of other underground utilities shall be as shown on the plans and/or in accordance with applicable state and local laws and regulations. Refer to Section 33 01 00 for additional requirements.
- F. All excavated material suitable for backfilling shall be placed in an area away from the trench edges so as to avoid overloading, sliding, and cave-ins.
- G. The areas immediately adjacent to the trench shall be graded as required to prevent surface water from entering the trenches.

3.02 EXCAVATION FOR APPURTENANCES

- A. A minimum of twelve (12) inches shall be left between the trench wall and the outside surface of the appurtenance.

3.03 SHEETING, SHORING AND BRACING

- A. Refer to Section 31 23 14 of these specifications

3.04 ROAD, STREET, AND DRIVEWAY CROSSINGS

- A. At such road and all other crossings as may be designated by the Engineer, the trenches are to be mechanically tamped and filled in such a manner as to prevent any serious interruption of traffic upon the roadway or crossing.
- B. Not more than one street crossing may be obstructed by the same trench at any one time except by permission of the Engineer and Owner.

3.05 ROCK EXCAVATION

- A. Rock excavation shall be completed to a minimum of eight (8) inches below and on each side of all pipes, valves, fittings, and other appurtenances.
- B. Excess excavation shall be backfilled with compacted material conforming to the bedding material required for the material being used.

3.06 DEWATERING

- A. Where water is encountered in a trench, water shall be removed by pumping to lower the water level to such elevation that the pipe may be laid dry at the grade shown on the plans.
- B. All water pumped from the trench shall be disposed of in a manner so as not to cause any damage to adjacent property.
- C. When dewatering is paid for, it shall be considered as dewatering only when a manifold or pump and system of well points is installed to lower ground water such that excavation and construction can take place.
- D. The process of pumping water out of the trench with a suction hose and pump will not be considered as dewatering.
- E. Where seepage of water into the trench occurs that can be removed using standard pumping procedures, it shall not be deemed sufficient cause for installing a system of manifolds and well points and classified as dewatering in order to obtain remuneration under the Bid Item - Dewatering.
- F. A dewatering permit is required when the discharge from dewatering may reach the waters of the state. To obtain information on the General Dewatering Permit, the Contractor should contact the Department of Agriculture and Natural Resources at (605) 773-3351.

3.07 TRENCH BOTTOM PREPARATION

- A. The sides of all trenches shall be vertical from the bottom of the trench to a point one (1) foot above the top of the pipe.
- B. The width of the trench shall be a minimum of twelve (12) inches on each side of the pipe bell.
- C. The bottom of all trenches for underground piping shall be carefully and accurately formed to the lines and grades as shown on the plans, set by the Engineer or as specified herein.
- D. Rock, boulders, and large stones, or other manmade material shall be removed to provide a clearance of at least eight (8) inches below the outside barrel of the pipes, valves, fittings appurtenances. Adequate clearance for properly jointing pipe laid in rock trenches shall be provided at bell holes. The space between the rock at the bottom of the trench and the bottom of the pipe barrel shall be filled with compacted bedding material.
- E. If the trench bottom is inadvertently excavated deeper than necessary, it shall be backfilled to the proper grade with compacted bedding material.

3.08 UNSTABLE TRENCH BOTTOM

- A. Whenever wet, soft or unstable soils incapable of properly supporting the pipe, or other appurtenances are encountered in the trench, the Contractor shall be required to remove the unsuitable materials and backfill to the proper grade with concrete, granular material or other suitable approved material.
- B. Backfill material shall be compacted to provide a firm and level support for the piping system. Firm support is defined as no visual deformation in the surface when workers walk on the compacted material.

3.09 BACKFILLING AND COMPACTING

- A. Any trenches improperly backfilled or showing excessive settlement shall be reopened to a depth required for proper compaction.
- B. Backfill material shall be free of boulders, frozen clods, large roots, excessive sod or other vegetation, construction debris.
- C. No backfilling shall take place in freezing weather without written permission from the Engineer.
- D. Borrowed granular bedding material shall conform to the gradation indicated below.

Sieve Opening	Bedding Material (Percent Passing)
1"	95-100
No. 200	< 15

- E. Bedding material excavated from the job site shall be finely divided material free from organic material and clods, lumps of frozen material or stones larger than 1 1/2" in maximum diameter. Bedding material shall be of proper moisture content to form a firm bed for the pipe.
- F. The bedding material backfilling around the pipe shall be deposited in layers not to exceed eight inches (8") and carefully compacted to a degree of compaction at least equal to 90% maximum dry density as determined by Standard Proctor Test, ASTM Test Designation D698 throughout the entire depth of each layer. Where the pipe has a protective coating, care shall be taken not to damage the coating.
- G. The embedment material shall be finely divided material free from debris, organic material, and clods, lumps or stones larger than 1-1/2 inches maximum diameter. The material shall be borrowed material or job site excavated material. Embedment material shall be placed in uniform layers not more than twelve (12) inches thick and compacted to 90% maximum density as determined by ASTM D698 until the pipe has a cover of not less than one (1) foot.
- H. The remainder of the backfill shall consist of selected material from excavation or borrow, and shall be free from cinders, ashes, refuse, organic and frozen material, boulders or other materials that are unsuitable. Stones larger than 3 inches in diameter shall not be placed within two feet of the top of the pipe. This material shall be placed from 12 inches above the top of the pipe to 6 inches below the ground surface, unless otherwise specified, or to the subgrade elevation for streets or paved surfaces.
- I. After completing the bedding and embedment of the pipe as specified above, the remainder of the backfill material beneath unpaved areas shall be placed in uniform layers not exceeding one (1) foot and tamped. It shall be the Contractor's responsibility to compact each layer throughout its entire depth to a degree of compaction at least equal to that of the surrounding earth. The Contractor shall moisten or aerate the backfill material to obtain the required compaction. The Contractor shall provide a final cover of topsoil as specified herein. Any additional settlement of the trench shall be brought back to grade with additional topsoil. The trench shall be left in a condition so as to present a neat appearance.
- J. Open trenches under road surfacing, sidewalks, curb and gutter, and other adjacent improvements to a point eight (8) feet from the edge of the road surface and as otherwise noted on the plans shall be backfilled with uniform layers not exceeding one (1) foot. Each layer, except the upper 6 inches of subgrade underlying the pavement, shall be spread uniformly and tamped with a hand tamper or other approved device until thoroughly compacted to at least 90% of the maximum density obtainable at optimum moisture content. The upper 6-inch layer, forming the subgrade for surfacing shall be compacted to at least 97% of the maximum density obtainable at optimum moisture content. Density of backfill shall be determined based on Standard Proctor Test, ASTM Test Designation D698.

3.10 TESTING REQUIREMENTS

- A. Frequency of Testing: Minimum of one (1) test every 250 feet to 350 feet of trench per lift or as directed by Engineer. Frequency of testing may be altered by Engineer after adequate testing is completed to determine level of effort by Contractor is sufficient. When frequency is altered by the Engineer, random testing will be performed to verify compaction efforts. The Contractor may be required to excavate to depths required by Engineer for testing and backfill test holes to density specified.
- B. Retesting: In the event of failure to meet compaction criteria, the Contractor shall re-excavate and re-backfill at direction of Engineer. All retesting to be paid for by Contractor and to be performed by soils testing firm secured by the Contractor and approved by the Engineer.

3.11 EXCESS EXCAVATION

- A. The Contractor shall be responsible for securing and maintaining an adequate area where excess excavation can be stockpiled for future use or wasted.
- B. The Engineer's approval on the site selection shall be required.
- C. The Contractor shall be responsible for the final cleanup of the site chosen. The site shall be cleaned to the satisfaction of the property owner, and a lien waiver or a letter of satisfaction written by the property owner and addressed to the Contractor shall be obtained by the Contractor and furnished to the Owner.

3.12 TOPSOIL

- A. All lawns areas shall be left smooth with a minimum of 6" of compacted black dirt throughout the entire area disturbed by the trench.
- B. Prior to topsoiling and finish grading, all rough grades shall be corrected, adjusted, and brought to the required elevations.
- C. The subgrade surface shall be prepared for topsoiling by cross disking to a depth of two (2) inches or more to permit bonding of the topsoil to the subgrade.
- D. All stones and other debris greater than two (2) inches in any dimension shall be removed from the surface of the subgrade prior to the placement of the topsoil.
- E. Topsoil material shall not be placed when the topsoil or subgrade is frozen or wet enough to cause clodding.
- F. Topsoiling operations adjacent to lagoons and along piping routes shall be considered complete when the finished surface is:
 - 1. Free of sticks, stones and other material one (1) inch or more in any dimension.
 - 2. Smooth and true to required grades with a maximum allowable deviation of 0.1 foot.
- G. All lawns shall be raked with a landscape rake, garden rake, or other approved equipment to remove all clods, stones, sticks, or other material greater than one (1) inch in any dimension. Trenches shall be slightly crowned and all disturbed areas smoothed to a maximum deviation of 0.1 foot and ready for seeding operations by Contractor prior to acceptance by the Engineer.

* * * END OF SECTION * * *

SECTION 31 34 19 – GEOTEXTILE FABRICS

PART 1 GENERAL

1.01 SUMMARY

- A. This section includes the requirements for furnishing and installing geotextile fabric as shown on the plans.

1.02 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions, apply to the Work specified in this section.
- B. Related Work specified elsewhere:
 - 1. Excavation and Fill - Section 31 23 00
 - 2. Aggregate Base Course - Section 32 11 23

1.03 QUALITY ASSURANCE

- A. When geotextile meeting or exceeding the required property values have been submitted and approved, the properties used for quality control shall be properties established by geotextile manufacturer for this type of product and not the values specified herein.

1.04 DELIVERY, HANDLING, AND STORAGE

- A. Geotextile shall be provided in rolls wrapped in relatively impermeable and opaque protective covers with the following clearly marked on each roll.
 - 1. Manufacturer's name.
 - 2. Product identification.
 - 3. Lot and roll number.
 - 4. Roll dimensions.
- B. Geotextile shall be stored in a dry location above the ground surface. Geotextile shall not be stored directly on the ground.
- C. Geotextile shall be handled in accordance with the manufacturer's recommendations to prevent damage to material during unloading, handling, and installation operations.

PART 2 PRODUCTS

2.01 GENERAL

- A. The Contractor shall furnish materials whose minimum roll values meet or exceed project requirements.
- B. The geotextile fabric shall have polymeric yarns or fibers oriented into a stable network to retain relative structure during handling, placement, and service.

2.02 GEOTEXTILE FABRIC PROPERTIES

- A. The Contractor shall provide a Certificate of Compliance verifying that the material meets the following specifications or documentation that the material is listed on the approved products list. If the type of fabric to be used is not specified, Geotextile Separator Fabric – Woven shall be used. All values listed are Minimum Average Roll Values (MARV) unless otherwise specified.
- B. The geotextile shall conform to the minimum physical property requirements for a Type B fabric listed in Table 1.
- C. The geotextile shall be furnished and stored at the site in a protective wrapping which shall protect

the fabric from ultraviolet radiation and from abrasion due to shipping and handling. If the geotextile is to be exposed directly to sunlight in excess of two weeks, the fabric shall be ultraviolet stabilized.

TABLE 1 - GEOTEXTILE AND IMPERMEABLE PLASTIC MEMBRANE

Fabric and Membrane Property	Test Method	Drainage Fabric		Silt Fence	Geotextile Separator		MSE Geotextile Fabric	Impermeable Plastic Membrane
		Type A	Type B		Woven	Non-Woven		
PERFORMANCE CRITERIA DURING SERVICE LIFE								
Equivalent or Apparent Opening Size, US Standard Sieve	ASTM D4751	40-100	40-100	20-70	* 40-100	40-100	40-100	---
Thickness, Mils	ASTM D1777	---	---	---	---	---	---	12
Permittivity, Sec-1	ASTM D4491	0.2 Min	0.3 Min	0.4 Min	0.05 Min	0.1 Min	0.005 Min	<0.000001 0 cm/sec ⁽⁶⁾
STRENGTH REQUIREMENTS								
Wide Width Strip Tensile Strength, lbs/inch Machine & X-Machine Direction	ASTM D4595 ⁽²⁾	40	90	---	130	65	200	80
Grab Strength, lbs Machine & X-Machine Direction	ASTM D4632	---	---	90 Min	---	---	---	---
Elongation at Failure, % Machine & X-Machine Direction	ASTM D4595 ⁽²⁾	40 Min	50 Min	---	20 Min	20 Min	35 Max	20 Min
Burst Strength, psi	ASTM D3786 Diaphragm Method	130	290	---	290	210	430	---
Trapezoid Tear Strength, lbs	ASTM D4533 Any Direction	25	75	---	50	40	75	50
Puncture Strength, lbs	ASTM D4833 ⁽³⁾	25	90	---	75	50	110	60
ENVIRONMENTAL REQUIREMENTS								
Mildew/Rot Resistance, %	AATCC 30 1988 ⁽⁵⁾	100	100	---	100	100	100	100
Insect/Rodent Resistance, %	AATCC 24 1985 ⁽⁵⁾	100	100	---	100	100	100	100
Ultraviolet Resistance, % Strength Retention	ASTM D4355	(4)	(4)	70	(4)	(4)	(4)	(4)
TYPICAL USES								
		a	b	c	d	d	e	f

*Note: The actual AOS of the silt fence should only have one value for AOS on the certification. To be approved the value shall be within the allowable range specified above.

⁽²⁾ 8" wide x 4" length (200 x 100 mm) specimen tested at a strain rate of 10% (0.4 inch) (10 mm) per minute.

- (3) Using 5/16" (8 mm) diameter flat tipped steel cylinder centered with ring clamp.
- (4) Non-stabilized or low susceptible geotextiles should not be exposed to ultraviolet radiation for more than 5 days.
- (5) American Association of Textile Chemists and Colorists test procedures.
- (6) Permeability Coefficient (ASTM D 4491).
- (a) Joints for concrete pipe culverts & RC boxes, edge drains, drainage tubing, etc. Used as a general filtration fabric.
- (b) Riprap, gabions, inslopes retention on MSE backfill, etc. Use-same as (a) except has a higher construction loading.
- (c) Medians, ditches, slopes, etc. Used to filter sediment-laden water.
- (d) Subgrades, embankments, etc. Used to separate granular material from subgrade.
- (e) Bridge End Backfill and reinforced slopes. Used to create a reinforced fill and/or used as the wall facing material.
- (f) Under pavements. Used to restrict the flow of fluids to underlying materials.

2.03 STAPLES

- A. Staples for the filter fabric, if used, shall be made of 11-gauge or heavier steel wire. The staples shall be "U" shaped with a 1-inch crown, and legs with a minimum of 8-inches in length.
- B. Installation shall be in accordance with the manufacturer's recommendations.

PART 3 EXECUTION

3.01 GEOTEXTILE INSTALLATION

- A. The Contractor shall install all geotextile fabrics according to manufacturer's recommendations and as specified herein.
- B. On side slopes, the geotextile shall be rolled down slope in such a manner as to continually keep geotextile in tension.
- C. In presence of wind, Contractor shall weight geotextile during placement with sufficient sand bags, or equivalent, to keep geotextile in place during placement of granular materials.
- D. During placement of geotextile, care shall be taken not to entrap in or under geotextile, stones, excessive dust, or moisture that could damage clay liner or hamper subsequent seaming operations.
- E. Do not expose geotextile to precipitation prior to or during installation, and do not expose geotextile to direct sunlight for more than 15 days, unless otherwise specified.
- F. All overlaps of geotextile fabrics shall be oriented in direction of earth filling.
- G. The Contractor shall repair all tears in geotextile prior to installation of granular materials. The repair procedures shall be as recommended by manufacturer and as outlined below.
 - 1. On slopes, a fabric patch shall be sewn in place over the tear with a minimum overlap of 24 inches in each direction. The patch shall be continually sewn using a double sewn lock stitch, seams 1/4 to 3/4 inches apart and no closer than 1 inch from any edge.
 - 2. Should any tear exceed 10% of the roll width, the roll shall be removed from the slope and replaced.
 - 3. On non-slopes, the fabric patch may be spot sewn with a minimum overlap of 24 inches in each direction.
 - 4. All soil or granular material, which may have penetrated torn geotextile shall be removed and the area grade smooth.
- H. Geotextile shall be installed around all appurtenances protruding through geotextile as recommended by manufacturer and as specified below.
 - 1. Holes for pipes and appurtenances shall be the minimum size necessary for installation.

2. The Contractor shall patch, seam, sew, or overlap the geotextile material around the pipe or appurtenances to provide a barrier against particle migration into or out of the geotextile fabric.

* * * END OF SECTION * * *

SECTION 32 11 23 AGGREGATE MATERIAL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the contract, including General and Special Conditions shall apply to work covered in this section.
- B. Related requirements specified elsewhere:
 - 1. Asphalt Concrete Surfacing - Section 32 12 16

1.02 DESCRIPTION OF WORK

- A. Aggregates shall be hauled, spread, compacted, and laid to grade as staked by the Owner's representative and shown on plans.

1.03 QUALITY ASSURANCE

- A. The finished grade of the base course shall be within 0.05 feet at any point, as staked and checked by the Owner's Representative.

PART 2 PRODUCTS

2.01 BASE COURSE

- A. The aggregates shall consist of sound durable particles of gravel and sand with which may be included limited amounts of fine soil particles. The physical characteristics and quality of the materials shall conform to the specifications of NDDOT Section 816.02 for Class 5 aggregates.

PART 3 EXECUTION

3.01 BASE COURSE

- A. Base course material shall be furnished and installed to obtain the desired grades, as shown on the plans. The base course material shall then be compacted-see Geotechnical report for % and moisture levels.

3.02 UNSUITABLE MATERIAL

- A. Unsuitable material shall be excavated and replaced with approved base course material as designated by the Owner or his Representative. No additional compensation shall be considered for this operation.

*** END OF SECTION ***

SECTION 32 12 16 ASPHALT CONCRETE SURFACING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the contract, including General and Supplementary Conditions shall apply to work covered in this section.
- B. Related requirements specified elsewhere:
 - 1. Bituminous Tack Coat – Section 32 12 13.13

1.02 DESCRIPTION OF WORK

- A. The work covered under these specifications shall include the furnishing of all labor, materials, and equipment necessary to lay a compacted asphalt concrete mat (at a depth as indicated in the plans), complete in place, as specified herein.

1.03 SUBMITTALS

- A. The Contractor shall submit for review copies of all certificates from the manufacturer that the materials meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

- A. The contractor shall provide the required control tests of the mineral aggregate for the asphalt surfacing. The cost is considered incidental to the project.
- B. The contractor shall provide the required job mix, prepared by an independent testing laboratory approved by the Engineer 14 days prior to start of production. The cost of the job mix designs shall be paid for by the Contractor and are considered incidental to the project.
- C. Following the Engineer's approval of the above-mentioned tests, all remaining tests shall be performed by the Owner's representative with results being given to both the Contractor and the Owner.

PART 2 PRODUCTS

2.01 GENERAL

- A. Specifications to be used for this section shall be the North Dakota Department of Transportation Standard Specifications for Road and Bridge Construction.

2.02 ASPHALT CONCRETE

- A. The construction requirements and material handling shall conform to the requirements of Section 430.
- B. Mineral aggregate for asphalt concrete shall conform to the requirements of the standard specifications for Superpave, FAA 40. The asphalt cement shall be PG 64-22 or PG 64-28. The Contractor shall provide a job mix formula with the supporting mix design data prior to production.
- C. A bituminous tack coat (SS-1H or CSS-1H) shall be applied between each lift at a rate of 0.10 to 0.15 gallon per square yard.

PART 3 EXECUTION

3.01 GENERAL

- A. The construction requirements and material handling shall conform to the requirements of Section 430 North Dakota Department of Transportation Standard Specifications for Road and Bridge Construction, 2024 Edition, except as modified hereinafter.

3.02 ASPHALT CONCRETE SURFACE

- A. Asphalt concrete surfaces will be replaced in the areas as designated by the Owner and Engineer.
- B. Placement of asphalt concrete surfaces shall be on compacted granular base course as indicated on the plans. The compacted thickness of asphalt concrete shall be as shown on the plans or as directed by the Owner and Engineer.
- C. The contractor shall adjust and cover all manholes and valve boxes, prior to tack coat application, with material approved by the Engineer.

3.03 GENERAL

- A. The Asphalt Concrete Paving equipment, weather limitations, job mix formula, mixing, construction methods, compaction, finishing, tolerance, and protection shall conform to the requirements of the appropriate sections of the State Highway Specifications for the type of material specified.

3.04 MIXING ASPHALTIC CONCRETE MATERIALS

- A. Provide hot plant-mixed asphaltic concrete paving materials.
 - 1. Temperature leaving the plant: 143 degrees C (290 degrees F) minimum, 160 degrees C (320 degrees F) maximum.
 - 2. Temperature at time of placing: 138 degrees C (280 degrees F) minimum.

3.05 SUBGRADE

- A. Shape to line and grade and compact with self-propelled rollers.
- B. All depressions that develop under rolling shall be filled with acceptable material and the area re-rolled.
- C. Soft areas shall be removed and filled with acceptable materials and the area re-rolled.
- D. Should the subgrade become rutted or displaced prior to the placing of the subbase, it shall be reworked to bring to line and grade.
- E. Proof-roll the subgrade with weighted dump truck as directed by Engineer. If pumping, pushing, or other movement is observed, rework the area to provide a stable and compacted subgrade.

3.06 BASE COURSES

- A. Base
 - 1. Spread and compact to the thickness shown on the drawings.
 - 2. Rolling shall begin at the sides and continue toward the center and shall continue until there is no movement ahead of the roller.
 - 3. After completion of the base rolling there shall be no hauling over the base other than the delivery of material for the top course.
- B. Thickness tolerance: Provide the compacted thicknesses shown on the Drawings within a tolerance of minus 0.0mm (0.0") to plus 12.7mm (0.5").
- C. Smoothness tolerance: Provide the lines and grades shown on the Drawings within a tolerance of 5mm in 3m (3/16 inch in ten feet).

D. Moisture content: Use only the amount of moisture needed to achieve the specified compaction.

3.07 PLACEMENT OF ASPHALTIC CONCRETE PAVING

A. Remove all loose materials from the compacted base.

B. Apply the specified prime coat, and tack coat where required, and allow to dry in accordance with the manufacturer's recommendations as approved by the Architect or Engineer.

C. Receipt of asphaltic concrete materials:

1. Do not accept material unless it is covered with a tarpaulin until unloaded, and unless the material has a temperature of not less than 130 degrees C (280 degrees F).
2. Do not commence placement of asphaltic concrete materials when the atmospheric temperature is below 10 degrees C (50 degrees F), not during fog, rain, or other unsuitable conditions.

D. Spreading:

1. Spread material in a manner that requires the least handling.
2. Where thickness of finished paving will be 76mm (3") or less, spread in one layer.

E. Rolling:

1. After the material has been spread to the proper depth, roll until the surface is hard, smooth, unyielding, and true to the thickness and elevations shown on the drawings.
2. Roll in at least two directions until no roller marks are visible.
3. Finished paving smoothness tolerance:
 - a. No depressions which will retain standing water.
 - b. No deviation greater than 3mm in 1.8m (1/8" in six feet).

3.08 PROTECTION

A. Protect the asphaltic concrete paved areas from traffic until the sealer is set and cured and does not pick up under foot or wheeled traffic.

3.09 FINAL CLEAN-UP

A. Remove all debris, rubbish, and excess material from the work area.

* * * END OF SECTION * * *

SECTION 32 16 00 CURBS, GUTTERS, SIDEWALKS AND DRIVEWAYS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions shall apply to the Work covered in this Section.
- B. Related requirements specified elsewhere:
 - 1. Trenching, Backfilling and Compaction - Section 31 23 33
 - 2. Asphalt Concrete Surfacing – Section 32 12 16

1.02 SCOPE

- A. This section covers the labor, materials, equipment and related services necessary to install or repair pavement and related structures damaged during construction.

1.03 QUALITY ASSURANCE

- A. The Contractor shall be responsible for obtaining the services of a qualified testing firm as may be required to assure compliance with the requirements of these specifications.

1.04 SUBMITTALS

- A. A complete description of the materials to be used in the Work covered by this Section of the specifications shall be submitted to the Engineer for review.
- B. Three (3) copies of all reports and test results completed by the independent testing service shall be submitted directly to the Engineer.

PART 2 PRODUCTS

2.01 CONCRETE

- A. See Division 030000.

PART 3 EXECUTION

3.01 GENERAL

- A. After completing proper compaction of the backfill, the Contractor shall replace the disturbed surfaces to the original grade. Surfacing material, as specified herein shall be replaced to the same depths and limits with the same type of material as the surfacing material removed, unless otherwise shown on plans.
- B. A flush, smooth, adjoining surface transition shall be provided.
- C. Existing asphalt paved surface, sidewalks, curb and gutter, concrete or asphalt driveways and alley approaches shall be scored along a straight line by a concrete saw to a depth of two (2) inches (or by a method previously approved by the Engineer) at a distance of two (2) feet beyond each edge of proposed ditch. The remaining thickness of surfaces shall be fractured to a true vertical face. All exposed faces shall be adequately cleaned to ensure bonding between new and existing surfaces and cut and fractured to a vertical face immediately prior to placement of the new surfacing.
- D. Placement of concrete or asphalt on frozen surfaces will not be permitted.
- E. Concrete surfaces shall be cured and protected for a sufficient period of time (not less than 3 days) to prevent damage to concrete and insure required compressive strength requirements.

3.02 CONCRETE SIDEWALK

- A. Concrete Sidewalk shall be replaced at locations as designated by the Engineer with nominal four (4) inch thick fiber reinforced concrete or six (6) inch rebar reinforced concrete sidewalk. Concrete sidewalk shall be poured on compacted gravel base course, at a depth as indicated on the plans.
- B. Sidewalk to be replaced shall be removed to nearest expansion or scored joint from each edge of the trench.
- C. Expansion joints shall be provided where walks abut a structure, at changes in directions, and at intervals of not more than 50 feet. Expansion joints shall be filled to within one inch of the surface with bituminous expansion joint material, and then filled flush to the surface with joint sealing compound. The joint sealing compound shall be finished slightly concave, and shall not be allowed to overflow the joint.
- D. Concrete walks shall be edged and grooved, with the grooves dividing each walk into equal length sections approximately equal to the width of the walk. Walks shall be floated smooth and even, and given a light broom finish at right angles to the length of the walk.

3.03 CONCRETE PAVEMENT

- A. Concrete Pavement, including driveways and heavy concrete sidewalk sections, shall be replaced at locations designated by the Engineer with six (6) inch thick, rebar reinforced concrete placed on compacted base course, at a depth as indicated on the plans.
- B. If an expansion or scored joint is within six (6) feet of the edge of the trench, the existing concrete shall be removed and replaced to the joint.
- C. The alignment of the new surface shall match that of the existing surface unless otherwise directed.
- D. The alignment and grade of the new surface shall match that of the existing surface unless otherwise directed.
- E. Expansion joints shall be filled to within one (1) inch of the surface with bituminous expansion joint material. Dowels shall be placed across the expansion joint at maximum 24" spacings.
- F. Contraction joints shall be provided at intervals of not more than ten (10) feet. Contraction joints shall consist of a groove of at least one third (1/3) the depth of the pavement sawed in green concrete or a plane of weakness formed by inserting a removable metal template.
- G. All expansion and contraction joints shall be filled flush to the surface with joint sealing compound. The joint sealing compound shall be finished slightly concave, and shall not be allowed to overflow the joint.
- H. Reinforcement shall consist of #4 deformed rebar placed at 24" OC both directions.

3.04 CONCRETE CURB AND GUTTER OR STRAIGHT GUTTER

- A. Curb and gutter shall be replaced to the thickness, geometric design, and alignment of the existing section with non-reinforced concrete on a 6-inch compacted gravel base course.
- B. In the event a joint is encountered within 5 feet of a proposed edge of the trench, the concrete shall be removed to such joint.
- C. Expansion joints shall be placed at changes in direction and at intervals not greater than 50 feet. Expansion joints shall be 1/2 inch wide, filled to within one inch of the surface with bituminous expansion joint material cut to the shape of the curb section. Dowels shall be placed across expansion joints as shown on the drawings or as directed.
- D. Contraction joints shall be provided at intervals of not more than 10 feet. Contraction joints shall consist of a groove at least 1-1/4 inches deep sawed in the green concrete or a plane of weakness formed by inserting a removable metal template.
- E. All expansion and contraction joints shall be filled flush to the surface with joint sealing compound. The joint sealing compound shall be finished slightly concave, and shall not be allowed to overflow the joint.

- F. All exposed edges of curbs and gutters shall be rounded with a suitable edging tool. Exposed surfaces shall be finished smooth and even with a steel trowel, and then given a light broom finish.

3.05 CONTRACTOR'S RESPONSIBILITY

- A. Any repaired areas which will include surface material and/or seeding requiring further repair due to trench settlement shall be repaired by the Contractor at his expense for a period of one year after written final acceptance of the project by the Owner.

* * * END OF SECTION * * *

**SECTION 329219
SEEDING**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preparation of subsoil.
- B. Placing topsoil.
- C. Seeding, mulching .
- D. Maintenance.

1.02 RELATED REQUIREMENTS

- A. Section 312200 - Grading: Preparation of subsoil and placement of topsoil in preparation for the work of this section.

1.03 DEFINITIONS

- A. Weeds: Include Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Topsoil samples.
- C. Maintenance Data: Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer .

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver grass seed mixture in sealed containers. Seed in damaged packaging is not acceptable. Deliver seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.
- B. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

2.02 SEED MIXTURE

- A. Seed Mixture:
 - 1. Kentucky Blue Grass: 155 PLS/Acre.
 - 2. Creeping Red Fescue Grass: 65 PLS/Acre.
 - 3. Fine-Leaf Perennial Ryegrass: 40 PLS/Acre.

2.03 SOIL MATERIALS

- A. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, taken from drained site; free of subsoil, clay or impurities, plants, weeds and roots; pH value of minimum 5.4 and maximum 7.0.

2.04 ACCESSORIES

- A. Mulching Material: Oat or wheat straw, free from weeds, foreign matter detrimental to plant life, and dry. Hay or chopped cornstalks are not acceptable.
- B. Water: Clean, fresh and free of substances or matter that could inhibit vigorous growth of grass.
- C. Erosion Fabric: Jute matting, open weave.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that prepared soil base is ready to receive the work of this Section.

3.02 PREPARATION

- A. Prepare subgrade in accordance with Section 312200.
- B. Place topsoil in accordance with Section 312200.

3.03 SEEDING

- A. Apply seed at a rate of 8 lbs per 1000 sq ft evenly in two intersecting directions. Rake in lightly.
- B. Do not seed areas in excess of that which can be mulched on same day.
- C. Do not sow immediately following rain, when ground is too dry, or during windy periods.
- D. Immediately following seeding and compacting, apply mulch to a thickness of 1/8 inches. Maintain clear of shrubs and trees.
- E. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.
- F. Following germination, immediately re-seed areas without germinated seeds that are larger than 4 by 4 inches.

3.04 PROTECTION

- A. Cover seeded slopes where grade is 4 inches per foot or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.
- B. Lay fabric smoothly on surface, bury top end of each section in 6 inch deep excavated topsoil trench. Provide 12 inch overlap of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil.
- C. Secure outside edges and overlaps at 36 inch intervals with stakes.
- D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.
- E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches.

3.05 MAINTENANCE

- A. Provide maintenance at no extra cost to Owner; Owner will pay for water.
- B. See Section 017000 - Execution Requirements, for additional requirements relating to maintenance service.
- C. Provide maintenance of seeded areas for three months from Date of Substantial Completion.
- D. Maintain seeded areas immediately after placement until grass is well established and exhibits a vigorous growing condition.
- E. Mow grass at regular intervals to maintain at a maximum height of 2-1/2 inches. Do not cut more than 1/3 of grass blade at any one mowing.
- F. Neatly trim edges and hand clip where necessary.
- G. Immediately remove clippings after mowing and trimming.
- H. Water to prevent grass and soil from drying out.
- I. Roll surface to remove minor depressions or irregularities.
- J. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
- K. Immediately reseed areas that show bare spots.
- L. Protect seeded areas with warning signs during maintenance period.

END OF SECTION

**SECTION 329300
PLANTS**

SECTION INCLUDES

1.01

SECTION 329300 PLANTS

- A. New trees, plants, and ground cover.
- B. Mulch and Fertilizer.
- C. Plant establishment.

PRICE AND PAYMENT PROCEDURES

DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Finish Grade: Elevation of finished surface of planting soil.
- C. Growing Season: A growing season is considered to be May 1 to October 1.
- D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.
- E. Pests: Living organisms that occur where they are not desired, or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- F. Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil or imported topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- G. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- H. Weeds: Any plant life not specified .
- I. Plants: Living trees, plants, and ground cover specified in this Section , and described in ANSI Z60.1.

REFERENCE STANDARDS

- A. ANSI A300 Part 1 - American National Standard for Tree Care Operations - Tree, Shrub, and Other Woody Plant Management - Standard Practices (Pruning); 2017.
- B. ANSI/AHIA Z60.1 - American National Standard for Nursery Stock; 2014.

SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. Mulch
 - 2. Weed Barrier
 - 3. Fertilizer
- B. Qualification Data: For qualified landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
 - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to project site.
 - 2. Pesticide Applicator: State licensed, commercial.
- C. Maintenance Agreement: Statement of required maintenance period, duties to be performed, name and contact information of individual responsible for overseeing maintenance services.
- D. Maintenance Instructions: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before start of required maintenance periods.
- E. Statement of Warranty. Describing an understanding of the required warranty. Provide name and phone number for responsible contact.

QUALITY ASSURANCE

- A. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
- C. Pre-installation Conference: Schedule a pre-planting meeting to review preparation and planting requirements with the Architect and Contractor prior to planting. All plants, trees and shrubs shall be planted in accordance with all the drawings and specifications included in the plans.

DELIVERY, STORAGE, AND HANDLING

- A. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.
- B. Protect and maintain plant life until planted.
 - 1. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
 - 2. Handle planting stock by root ball.
 - 3. Deliver plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
 - 4. Trees may not be stored on site for more than 24 hours prior to planting without prior approval and installation of moisture retaining cover or bedding around all root balls.

FIELD CONDITIONS

- A. Do not install plant life when ambient temperatures may drop below 35 degrees Fahrenheit or rise above 90 degrees Fahrenheit.
- B. Do not install plant life when wind velocity exceeds 40 mph.

WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship or growth within the specified warranty period.
- C. Failures include, but are not limited to: death and unsatisfactory growth, lack of adequate maintenance and damage from falling or blowing over. The Contractor will be responsible to remove all dead plantings and trees immediately upon notification from the Architect, even if the replacement is not immediate. This requirement applies during the warranty period as well.
- D. The Architect will monitor trees planted by the contractor as part of the construction contract. Trees that die prior to completion of the project will be reported to the contractor and must be removed immediately. Replacement trees will be planted as directed at no additional cost to the City.
- E. The Parks Department will monitor the trees during the warranty period. If a tree meets the criteria below, the Park Forestry Supervisor will advise the Architect of the need to meet on site to confirm that the tree is dead. A picture of the dead tree will then be taken, and the tree will be removed by the Forestry Crew. The Architect will follow up with the contractor to have the tree
 - 1. replaced at no additional cost to the Owner. Criteria for identifying a dead tree:
 - 2. Leaves are brown during the summer.
 - 3. Tree loses its leaves during the summer.
 - 4. Buds are dry and brittle.

5. Brittle branches that break when bent.
 6. The surface beneath the bark of the tree is brown. To check, take a pocket knife and scrape the surface just below the bark. If the surface beneath the bark is green, then the tree is not dead.
- F. All plants, trees and shrubs shall be warranted for ONE YEAR from date of Project Final acceptance . At the end of the warranty period the Architect shall make an inspection of the project and dead, unhealthy, or otherwise not acceptable plants, trees, and shrubs shall be replaced by the Contractor at no additional cost to the Owner.
1. Notify the Owner and Architect in writing immediately upon completion of any warranty replacement plantings. For replacements after the initial establishment period has expired the Contractor shall water replacement plants for one week, after which the Owner assumes responsibility for watering replacement plants. If written notice is not provided the Contractor shall continue to water replacement plants until notice requirements are fulfilled.
 2. An intermediate warranty inspection may occur prior to the one year warranty expiration. Replacement is required within 60 days of the intermediate warranty inspection.
 - a. If a plant replaced during the intermediate warranty period dies prior to the final warranty the contractor is not required to install a second replacement without additional compensation. Requests for additional compensation must be approved prior to proceeding with the work.
 3. Notify the Architect in writing with any concerns regarding Owner Maintenance of plant material during the warranty period.

PART 2 PRODUCTS

10.01 PLANTS

- A. Plants: Species and size identified in plant schedule, grown in climatic conditions similar to those in locality of the work.
- B. General: All plants, trees and shrubs shall conform to or exceed minimum quality standards as defined by the American Nursery and Landscaping Association, current edition of ANSI Z60.1, and shall be purchased from a licensed Landscape Nursery. Plants, trees and shrubs furnished shall be of the same genus, species, cultivar and size as specified in the plans. Species and variety may be substituted only by the approval of the Landscape Architect. Each plant, tree and shrub shall have an identification label, removed after the Substantial Completion inspection.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

SOIL AMENDMENT MATERIALS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, with a minimum of 25% SCU for slow release properties in the following composition:
 1. Composition: 13-13-13.
 2. Application rate: 330 lbs/acre.

MULCH MATERIALS

- A. Organic Mulch: Shredded cedar mulch.
 1. Color: undyed natural wood.
 2. Particle size and consistency: a general mixture of fibers 3 inches in length or less.
 3. Remove any large mulch chunks that do not meet the requirements above.
- B. Weed Barriers
 1. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric.
 2. Available Products:
 - a. DeWitt Pro 5
 - b. SRW Products Pro Plus V

- c. Or approved equal.

PESTICIDES

- A. General: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.
- C. Pre-Emergent Herbicide: Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- D. Pesticides shall be incidental to the landscaping bid items.

ACCESSORIES

- A. Treegator slow release watering bag, or approved equal; www.treegator.com
 - 1. Size: 20 Gallon
 - 2. Supply and install one per tree.

PART 3 EXECUTION

15.01 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.
 - 1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
 - 2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
 - 3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
 - 4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Prepare surface soil:
 - 1. Kill existing weed growth with non-selective herbicide a minimum of two weeks prior to planting date. Apply a second application as necessary a minimum of 24 hours prior to planting.
 - a. Apply at rate recommended by manufacturer.
 - 1) Loosen surface soil to a depth of at least 6 inches.
 - 2. Remove stones larger than 1-1/2 inches. in any dimension and sticks, roots, trash, and other extraneous matter.
 - a. Legally dispose of waste material, including grass, vegetation, and turf, off Owner's property.
- D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove

ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

- E. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

FERTILIZING

- A. Apply fertilizer in accordance with manufacturer's instructions.
- B. Apply after initial raking of topsoil.
- C. Mix thoroughly into upper 2 inches of topsoil.

TREE AND SHRUB PLANTING

- A. Place plants as indicated.
- B. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1.
 - 1. Expose root flare; root flare may have been buried in the root ball during growing or tree harvesting operations.
- C. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- D. Excavate planting pits with sides sloping inward at a 30-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
 - 1. Excavate approximately five times as wide as ball diameter.
 - 2. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
 - 3. Hand dig tree planting pits when in close proximity to existing utilities.
- E. Set stock plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.
 - 1. Use planting soil for backfill.
 - 2. Balled and Burlapped: After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
 - 3. Container-Grown: Carefully remove root ball from container without damaging root ball or plant.
 - 4. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
 - 5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- F. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.
- G. Set plants vertical.
- H. Remove non-biodegradable root containers.

PLANT SUPPORT

- A. Trunk stabilization is not required unless deemed necessary by the Architect to maintain the tree in an upright position. Tree staking may be requested at any time between planting and expiration of the plant warranty period.
 - 1. Upright Staking and Tying: Use three stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend one-third of trunk height above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.

2. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

TREE PRUNING

- A. Prune trees as recommended in ANSI A300 Part 1.
- B. Prune newly planted trees as required to remove dead, broken, and split branches.

PERENNIAL AND ORNAMENTAL GRASS PLANTING

- A. Set out and space perennial plants and ornamental grasses according to plan and in even rows with triangular spacing.
- B. Use planting soil for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- E. Water thoroughly within two hours after planting, taking care not to cover plant crowns with wet soil.
- F. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

PLANTING AREA MULCHING

- A. Weed barrier fabric shall be placed at the areas specified in the plans. Weed barrier fabric shall be anchored to the ground with 6" U shaped staples. The staples shall be placed at a 4' spacing along all edges, overlaps, and throughout the area of weed barrier fabric. The weed barrier fabric shall be overlapped 4" between rolls.
- B. Mulch backfilled surfaces of planting areas and other areas indicated.
 1. Trees in Turf Areas: Apply organic mulch ring of 4-inch average thickness, with 5-foot minimum diameter around trunks or stems or 12-inches outside dripline of evergreen trees. Do not place mulch within 3 inches of trunks or stems.
 2. Organic Mulch in Planting Areas: Apply 4-inch average thickness of organic mulch over whole surface of planting area. Finish level with adjacent finish grades.
 - a. Do not place mulch within 3 inches of trunks or stems.
 3. Apply pre-emergent herbicide according to manufacturer's written instruction.

WATERING

- A. The Contractor is required to provide adequate water for all newly planted landscape material during the Establishment period.
- B. A 20 gallon Treegator Slow Release Watering Bag shall be provided and installed with each tree. www.treegator.com. Each tree bag shall be refilled at least twice per week.
- C. An inspection will be performed at the end of the establishment period to ensure the landscape material is alive and growing. Maintenance and replacement shall be at the expense of the Contractor. Replaced landscape material shall be watered as required for original plantings at the expense of the Contractor.
- D. Watering Restrictions: the Contractor must comply with all watering restrictions in place. A listing of watering restrictions can be found on the City's website. If even/odd or more restrictive watering restrictions are in place, a watering permit must be obtained from the Public Works Office. This permit will allow daily watering (outside the noon to five restrictions) for a period of up to 4 weeks. After 4 weeks, the Contractor must comply with the current watering restrictions. For clarification, the whole project will be treated as one address so the watering can occur on the entire project on the same day.
- E. The Contractor shall not utilize adjacent property owner watering system without their permission. If the Contractor chooses to do so, it will be the Contractor's responsibility to reimburse the property owner for the water used.

3.10 ESTABLISHMENT

- A. Provide maintenance during establishment period at no extra cost to Owner; Owner will pay for water.
- B. Maintain plant life for a period beginning with installation and continuing for 45 days from date of Project Substantial Completion.
 - 1. During the establishment period the Contractor shall be on site a minimum of one hour per week throughout the maintenance period to monitor plants, water, adjust irrigation, and weed as necessary.
 - 2. When maintenance period has not elapsed before the end of the growing season continue maintenance during the next growing season.
 - 3. Notify the Architect in writing upon termination of the required maintenance services. The Contractor shall continue maintenance services until written notification is provided.
- C. Irrigate sufficiently to saturate root system and prevent soil from drying out.
- D. Cultivate and weed plant beds and tree pits.
- E. Remove dead or broken branches and treat pruned areas or other wounds.
- F. Neatly trim plants where necessary.
- G. Immediately remove clippings after trimming.
- H. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions.
- I. Control insect damage and disease. Apply pesticides in accordance with manufacturers instructions. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- J. Remedy damage from use of herbicides and pesticides.
- K. Fill settled areas with planting soil as necessary. Remove and replace landscape and mulch materials damaged or lost in areas.
- L. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

END OF SECTION

SECTION 33 01 00 EXISTING UNDERGROUND UTILITIES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the contract, including General and Supplementary Conditions shall apply to the Work covered in this Section.

1.02 SCOPE

- A. This Section describes, but is not limited to, the relationship of the Project to existing underground utilities and the Work associated with the location, adjustment, and repair of underground utilities.
- B. The information and data relative to existing underground utilities are provided to assist the Contractor with the preparation of his bid. This information should not be used by the Contractor for reference during construction of the Work.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL

- A. Existing underground utilities, as shown on the drawings, are located in accordance with available data, but locations may vary and cannot be guaranteed. The exact locations shall be determined by each Contractor as the Work proceeds. Excavation work shall be done carefully so as to avoid damaging the existing utilities and Work.
- B. Each Contractor shall provide for protection, temporary removal and replacement or relocation of obstructions as required for the performance of this Work required in these contract documents.
- C. Other obstructions not shown on the plans and requiring relocation shall be exposed by the Contractor without injury; or if injured, shall be repaired by Contractor at his expense. Removal of such obstruction or its relocation shall be made by the Contractor according to the provisions of the General Conditions.

3.02 UTILITY CONTACT

- A. Prior to Work in a specific area affecting underground utilities, the following individuals shall be notified as appropriate:
- B. All above utilities, excepting water, may be located utilizing the One Call Notification Center:
(Locate Phone Number) 1-800-781-7474
(Admin. Phone Number) 1-800-422-1242
- C. The failure of any utility to be present for any reason, at the Pre-Construction Conference, if held, shall not relieve the Contractor of any responsibility described herein.

3.03 UTILITY REPAIR:

- A. When an underground utility is exposed or damaged, the Contractor shall comply with the repair requirements of the affected utility.
- B. When an underground utility is exposed, the Contractor shall compact the backfill beneath the exposed utility before completion of the backfill operation.

3.04 SANITARY/STORM SEWER AND WATER MAIN SEPARATION:

- A. Horizontal Separation - Sewers shall be laid at least 10 feet (3.0 m) horizontally from any existing or proposed watermain. The distance shall be measured edge to edge. In cases where it is not practical

to maintain a 10 foot (3.0 m) separation, the Department may allow deviation on a case-by-case basis, if supported by data from the design engineer. Such deviation may allow installation of the sewer closer to a watermain, provided that the watermain is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation so the bottom of the watermain is at least 18 inches above the top of the sewer.

- B. If it is impossible to obtain proper horizontal separation as described above, both the watermain and sewer shall be constructed of slip-on or mechanical joint pipe complying with public water supply design standards of the Department and be pressure tested in accordance with AWWA standards to assure water tightness before backfilling.
- C. Vertical Separation
 - 1. Sewers Crossing Under Watermains - The sewer shall be laid to provide a minimum of 18 inches from the top of the sewer to the bottom of the watermain. The crossing shall be arranged so the sewer joints will be equidistant and as far as possible from the watermain.
 - 2. Sewers Crossing Over Watermains - Either the watermain or the sewermain must be encased in a watertight carrier pipe that extends 10 feet (3.0 m) on both sides of the crossing, measured perpendicular to the watermain. The carrier pipe shall be PVC, ABS, or HDPE, and the ends sealed with a rubber gasket or boot.
 - 3. Special Conditions - When it is impossible to obtain the proper horizontal and vertical separation as stipulated above, one of the following methods shall be specified:
 - 4. Water Pipe - The sewer shall be designed and constructed equal to water pipe and shall be pressure tested in accordance with AWWA standards prior to backfilling to assure water tightness; or;
 - 5. Carrier Pipe - Either the watermain or the sewermain may be encased in a watertight carrier pipe that extends 10 feet (3.0 m) on both sides of the crossing, measured perpendicular to the watermain. The carrier pipe shall be PVC, ABS, or HDPE, and the ends sealed with a rubber gasket or boot.
- D. Storm Sewer Requirements:
 - 1. A reinforced concrete pipe (RCP) storm sewer may cross below a watermain with a separation of less than 18 inches or at any height above a watermain provided the joints on the RCP within 10 feet of either side of the watermain are assembled with:
 - 2. Preformed butyl rubber sealant meeting federal specification #SS-S-210A and AASHTO M 198, and each of these joints are encased with a minimum 2-foot wide by 6-inch thick concrete collar centered over the joint and reinforced with the equivalent steel area as that in the RCP. Encasement of the watermain will not be required when the RCP joints are collared within the 20-foot section.
 - 3. An O-ring that conforms to ASTM C 443 specifications. O-rings are manufactured for concrete pipe with diameters up to 18 inches.
 - 4. A strip of impermeable material held in place with stainless steel bands and tested to 5 psi prior to the storm sewer being put into use.
- E. There shall be at least a 10-foot horizontal separation between watermains and sanitary sewer forcemains. There shall be an 18-inch vertical separation at crossings as required in paragraphs B and C.

PART 4 MEASUREMENT AND PAYMENT

4.01 METHOD OF MEASUREMENT

- A. The cost to repair any underground utilities or other obstructions damaged by the Contractor's activities shall be considered incidental Work with no separate measurement made.

4.02 BASIS OF PAYMENT

- A. The cost to repair any underground utilities or other obstructions damaged by the Contractor's activities shall be considered incidental Work with no separate and payment to be made.

*** END OF SECTION ***

SECTION 33 11 00 WATER UTILITY PIPING AND FITTINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions shall apply to the Work covered in this section.
- B. Related Work Specified Elsewhere:
 - 1. Trenching, Backfilling and Compacting - Section 31 23 33
 - 2. Standard Drawing 33 11 00-1

1.02 DESCRIPTION OF WORK

- A. The work covered under these specifications shall include the furnishing of all labor, material, tools, and equipment necessary to furnish and install, complete in place, all piping and fittings as shown on the drawings and as specified herein.

1.03 SUBMITTALS

- A. The Contractor shall submit for review copies of shop drawings for materials specified herein.
- B. Certificates from the manufacturer that the materials meet or exceed specified requirements.
- C. The manufacturer's installation recommendations, including types and amounts of gasket lubricant, where applicable, to be used.
- D. Certification shall be provided that all pipes, plumbing fittings, and fixtures are "Lead Free" in accordance with the January 4, 2011 modification to Section 1417 of the Safe Drinking Water Act.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. All materials shall be packed, loaded, transported, unloaded, and handled in such a manner so as to prevent damage to the materials.
- B. All material shall be loaded and unloaded by lifting with slings or hoists or skidding so as to avoid shock or damage. Dropping or rolling will not be permitted. The use of end hooks to install or move piping will not be allowed.
- C. All materials shall be stored on the site in accordance with the manufacturer's recommendations. Do not store materials directly on the ground.
- D. All materials shall be kept clean and dry. The insides of all piping and fittings shall be kept free of dirt and debris.

PART 2 PRODUCTS

2.01 DUCTILE IRON FITTINGS

- A. Ductile iron fittings shall conform to the requirements of AWWA/ANSI Specifications C110/A21.10 & C153/A21.53.
- B. Ductile Iron Fittings to be installed underground shall be mechanical joint type conforming to the requirements of AWWA/ANSI Specifications C111/A21.11.
- C. Ductile Iron Fittings to be installed in "non-buried" locations shall be provided with flanged joints with rubber full-face gaskets. Flanged faces shall be drilled to standard 125-pound template unless otherwise noted.

- D. All Ductile Iron Fittings shall be lined with cement mortar in accordance with AWWA/ANSI Specifications C104/A21.4. The exterior finishes shall be an asphaltic varnish coating not less than 1-mil thick.
- E. When utilized for contaminated soils areas, the fittings will be furnished with Nitrile Butadiene gaskets.

2.02 PRESSURIZED POLYVINYL CHLORIDE (PVC) PIPE

- A. All Polyvinyl Chloride pipe shall be pressure class 150 AWWA C-900 rated pipe with rubber gasket sealed joints.
- B. The pipe shall be made from Type 1, Grade 1, Class 12454-B compounds conforming to ASTM D1784 with a hydrostatic design basis (HDB) of 4,000 psi as per ASTM 2837.
- C. All pipes shall be marked with the following: Nominal pipe size, material code designation, SDR, pressure rating, manufacturer's name or trademark, NSF seal and ASTM numbers.
- D. The PVC pipe shall be furnished in 20 foot laying lengths. Longer lengths will be allowed only if the Contractor certifies that he will provide equipment on the project to fully support the pipe while being transported and distributed over the project.
- E. All PVC pipe shall be furnished with gasket joints conforming to ASTM D3139. Rubber gaskets shall conform to the requirement of ASTM F477.
- F. Manufacturer's proof of design tests and joint dimensions shall be submitted to the Engineer for gasket joints, which do not maintain SDR throughout the joint.
- G. Gasket joint couplings used for plain end pipe shall have a pressure rating equal to the pipe on which used. Centering of pipe within the coupling will be assured by means of an integral positive stop in the coupling. All couplings must be of the double gasket type. Couplings requiring welds will not be allowed.
- H. All gasket joints shall have a seating depth equal to at least 50% of the nominal pipe diameter.
- I. The ends of the pipe to be inserted into couplings or joints shall be factory marked to allow field checking of the depth of setting of the pipe in the joint socket.

2.03 FITTINGS FOR PRESSURIZED PVC PIPE

- A. Repair couplers and gaskets will be pressure Class 150 PVC pressure fittings meeting the requirements of:
 - 1. AWWA-C907 (also referred to as C900 fittings)
 - 2. ASTM D-1784, Materials
 - 3. ASTM D-3139, Joints
 - 4. ASTM F-477, Gaskets
 - 5. NSF Standard 61, Suitability for Potable Water
- B. All other fittings for use on PVC C-900 Class 150 pipe shall be ductile iron fittings conforming to the requirements of paragraph 2.02 above, with the exception of transition couplers as specified in paragraph 2.05 below.

2.04 TRANSITION COUPLERS

- A. The couplings used for transitions between piping of different materials, piping of different diameters, and existing piping to new piping (excluding repair couplers), shall be a wide-range flexible coupler with a sleeve type design meeting the requirements of AWWA C219.
 - 1. The coupling body shall be a center sleeve fabricated of high strength carbon steel tubing equivalent to ANSI/AWWA C200. The transition couplers will be readily available in nominal diameter ranges from 1.5 to 24 inches on all pipe classes.

2. Compression End Rings: One gasket compression end ring per coupling end. End rings to be of either one, two, or four bolt design, fabricated of carbon steel equivalent to ASTM A576.
 3. Hydraulic Wide Range Gasket: Chloramine Resistant NSF-61 approved EPDM gasket designed with a multi-layered wide range removable outer layer. Gasket hydraulically actuated with a pressure-equalizing dam, pressure cavity and sealing lip for working pressure of 260 psi (1.5 to 16 inches) and 232 psi (18 to 24 inch nominal diameter coupling).
 4. Fasteners shall be grade 304 (A2) or 316 (A4) stainless steel with yield strengths that conform to all nationally recognized standards. Bolts to be coated with an anti-seize type coating to prevent galling.
 5. The interior and exterior coatings shall NSF-61 approved fusion bonded epoxy coating conforming to AWWA C213.
 6. When properly installed the coupling will provide a minimum deflection of 8 degrees, up to 260 psi working pressure and 3/8 inch longitudinal pipe movement without leakage. (Flanged adapters will provide half the longitudinal movement and deflection.)
 7. All products will be proof tested to a minimum of 1.5 times working pressure.
- B. Flanged couplers shall consist of one compression end and gasket, coupling center sleeve, and AWWA Class "D" Flange (per AWWA C207).
- C. Pre-Approved transition couplers are: "Macro" extended range coupling by Romac Industries, Inc.; Omega Series Style CRCER by Cascade Waterworks Mfg. Co.; Maxi-Range Pipe Coupling by Mueller Co.; or Engineer approved equal.

2.05 FASTENERS

- A. All fasteners in buried locations shall be Grade 304 (A2) or Grade 316 (A4) stainless steel. Anti-Seize shall be applied to all threads prior to installation.

2.06 LUBRICANT FOR PIPE GASKETS

- A. Lubricant shall be an emulsified polymer based product, specifically formulated to be water-soluble without causing turbidity. Lubricant shall not transfer taste and/or odor to new water main installations. Lubricant must not promote bacterial growth and be safe for use on all metal and plastic pipes. Lubricant shall be easily flushed from the line and be non-reactive to chlorinated water. Lubricant should work easily on both wet and dry surfaces.

2.07 POLYETHYLENE WRAP

- A. All ductile fittings shall be wrapped with polyethylene plastic film having a minimum thickness of 0.006 inches or with a cross woven polyethylene plastic film having a minimum thickness of 0.004 inches.

2.08 TRACER WIRE

- A. Tracer wire shall be 12-gauge solid copper or high strength stainless steel wire with a 45-mil polyethylene coating. Provide sufficient length to be continuous over each separate run of nonmetallic pipe.
- B. Corp Stop compression joints will be provided with an optional tracer wire hole that has a set screw for a positive connection. Curb Box lids will also be provided with a tracer wire screw that is tapped into the bottom of the lid for securing a quick connect eyelet terminal. Once tightened, the threaded end of the screw becomes accessible for attaching an alligator clip at the top of the lid.
- C. All tracer wires are to be connected to a combination cast iron & ABS/PVC tamper proof tracer wire access box. The cover is to be manufactured of cast iron and ABS/PVC components produced in the USA. Cast iron collar & cover is to be manufactured in accordance with ASTM A48 Class 25. The ABS is to be manufactured in accordance with ASTM D 1788. The cover shall be lettered "Water" and shall have a standard AWWA size cast-in pentagonal bolt. Box will be a minimum of 3 inches in diameter and adjustable from 18 to 24 inches.

2.09 BEDDING MATERIAL

A. Borrowed granular bedding material shall conform to the gradation indicated below.

<u>Sieve Opening</u>	<u>Bedding Material (Percent Passing)</u>
1"	95-100
No. 200	< 15

B. Bedding material excavated from the job site shall be finely divided material free from organic material and clods, lumps of frozen material or stones larger than 1 1/2" in maximum diameter. Bedding material shall be of proper moisture content to form a firm bed for the pipe.

PART 3 EXECUTION

3.01 GENERAL

A. The areas to receive piping shall be examined for defects that may adversely affect the execution and quality of Work. Prior to the start of piping installation, all measurements shall be checked for deviations from allowable tolerances for piping.

3.02 BURIED PIPING INSTALLATION

- A. All piping and fittings shall be laid true to line and grade as shown on the plans. Each section of pipe shall be so laid and fitted together that when complete the piping will have a smooth uniform flow line. The inside of all pipes shall be cleaned before installation and kept thoroughly clean during and after the laying. Pipe ends shall be cleaned inside and outside.
- B. Apply lubricant liberally to the inside of the pipe bell and spigot. Make sure lubricated surfaces remain free of dirt, gravel or other debris. Assemble the pipe joint immediately after application of the lubricant.
- C. All pipe and fitting shall be examined for defects before being lowered into the trench. The interior and exterior protective coating shall be inspected and field repaired, if required, and possible accordance with applicable standards.
- D. The pipe shall be handled and installed in accordance with manufacturer's recommendations and the requirements of AWWA C600 for Ductile Iron pipe, ANSI/AWWA C605 and ASTM D2774 for PVC pipe.
- E. When pipe laying is not in progress, including the noon hours, the open ends of pipe shall be closed. No trench water, animals, or foreign material shall be permitted to enter the pipe.
- F. Granular Bedding shall be used as bedding material. After each pipe has been graded, aligned, and placed in final position on the bedding material and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent pipe joining and embedment operations. Granular Bedding shall be placed as in Class C Bedding on Standard drawing 331100-1. Bedding material shall be as specified in Part 2.
- G. The pipe shall be laid upon properly placed bedding material so that the barrel of the pipe will have a bearing for its full length. Bell holes and depressions for joints shall be excavated after the trench bedding has been graded.
- H. The Contractor shall provide and maintain all necessary means and devices at all times to remove and dispose of all water entering the trench during the process of pipe laying. The trench shall be kept dry until the pipe laying and jointing are completed. Removal of water shall comply with Section

31 23 33.

- I. Thrust blocks or restraining fittings to restrain pressurized piping shall be provided at all abrupt changes in direction, tees, bends, dead ends and hydrants, and shall be in accordance with the pipe manufacturer's recommendations.

3.03 EXPOSED PIPING INSTALLATION

- A. Each item or system shall be furnished complete and installed as shown on the plans and in accordance with the manufacturer's recommendations, instructions, and directions. All installed equipment and systems shall be properly protected during subsequent construction operation.
- B. The Contractor shall inspect all material or equipment as it is received to determine damage and/or missing parts. It shall be his responsibility to repair or replace damaged items in accordance with the manufacturer's instructions.
- C. The Contractor shall provide all scaffolding required for the proper installation of this work in conformance with the standards of any local and state safety codes applying to scaffolding.
- D. All pipes shall be set such that the vertical and horizontal centerlines are properly aligned. Installation of piping by means of springing, forcing or stressing the pipe or adjacent fittings, valves or equipment will not be allowed.

3.04 MECHANICAL JOINTS AND COUPLINGS

- A. Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled or replaced. Over tightening bolts to compensate for poor installation practice will not be permitted.
- B. The holes in mechanical joints with tie rods shall be carefully aligned to permit installation of the tie rods. In flange and mechanical joint pieces, holes in the mechanical joint bells and the flanges shall straddle the top (or side for vertical piping) centerline. The top (or side) centerline shall be marked on each flange and mechanical joint piece at the foundry.

3.05 TRACER WIRE INSTALLATION

- A. Tracer wire shall be installed in the trench at the same time as the pipe or immediately prior to starting the backfill of the trench.
- B. Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.
- C. Splices will be allowed at pipeline intersections, manholes, bored crossings, and at other locations as agreed upon by the Resident Project Representative. Splices in tracer wire will be made with split bolt or compression-type connectors. Wire nuts may not be used. A waterproof connection is necessary to prevent corrosion. Splices shall be completed in accordance with the manufacturer's recommendations.
- D. Prior to final acceptance, all tracer wire shall be electrically tested for continuity from one exposed end to another.
- E. Tracer wire will be installed from Corporation Pack Joint to the Curb Stop. Attach wire to corporation stop compression nut and underside of curb stop box.
- F. Bring the wire to the ground surface at each fire hydrant and loop the wire in a tracer wire terminal box. These boxes shall be located between the hydrant and the hydrant valve with at least two feet of extra wire inside the box. The tracer wire terminal box must be installed flush with the finished grade.

3.06 TESTING

- A. All piping shall be tested in accordance with Section 33 13 01.

B. All piping shall be cleaned and flushed in accordance with the requirements of Section 33 13 00.

* * * END OF SECTION * * *

SECTION 33 12 16 WATER UTILITY DISTRIBUTION VALVES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions shall apply to the Work covered in this Section.
- B. Related requirements specified elsewhere:
 - 1. Watermain Piping and Fittings – Section 33 11 00
 - 2. Sanitary Sewer Piping and Fittings - Section 33 31 00

1.02 DESCRIPTION OF WORK

- A. This section covers the furnishing and installation of valves and appurtenances as specified herein and as shown on the plans.

1.03 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. All valves and related appurtenances shall be shipped in accordance to the requirements of AWWA C509 or C515. Valve ends shall be sealed to prevent the entry of foreign matter into the valve body. The boxes and crates in which valves are shipped shall completely enclose and protect the valve and accessories from foreign matter.
- B. Valves and accessories shall be stored in a manner so as to be protected from weather, moisture, and other possible damage. Materials shall not be stored directly on the ground.
- C. All material shall be handled in a manner that will prevent damage to the interior and exterior surfaces.

1.04 SUBMITTALS

- A. The Contractor shall submit for review copies of shop drawings for materials specified herein.
- B. Certification of performance, leakage, and hydrostatic tests as described in Section 5 of AWWA C-504 (Butterfly Valves) and/or AWWA C-509/515 (Resilient Seated Gate Valves) shall be furnished when requested by the Engineer.
- C. Certifications for all fasteners shall be provided for valves, fittings, and all other appurtenances provided under this specification.

PART 2 PRODUCTS

2.01 GATE VALVES

- A. Gate valves shall be resilient wedge type manufactured to meet all applicable requirements of AWWA Standard for Resilient Seated Gate Valve C509 or C515.
- B. All valves shall have non-rising stems, opening by turning left and provided with standard 2" square nut operator with arrow cast in metal to indicate direction of opening.
- C. Cast iron wedge shall have sealing surfaces of the wedge permanently bonded with resilient material to meet ASTM tests for rubber to metal bond ASTM D429. Each valve shall have a smooth unobstructed waterway free from any sediment pockets. Stuffing boxes shall be O Ring seal type with 2 rings located in stem above thrust collar. Low friction torque reduction thrust bearings shall be located both above and below the stem collar.
- D. Body and cover bolts and nuts shall be Grade 304 (A2) or 316 (A4) stainless steel. Anti-Seize shall be applied to all threads prior to installation.
- E. Exterior and interior coatings in accordance with ANSI/AWWA C550 for potable water.

- F. Non-rising stems shall be in full compliance with AWWA specification with cast integral stem collar and furnished of bronze conforming to ASTM B584 Alloy A. Stem nuts shall be independent of wedge and shall be made of solid bronze conforming to ASTM B 62.
- G. Valves shall have hydrostatic shell test of 400 psi and shut-off test of 200 psi. At the 200-psi shut-off test, valve must be bubble-tight with a zero (0) leakage allowance.
- H. Resilient wedge gate valves shall be the product of a manufacturer having a minimum of five (5) years experience in the manufacture of water works and distribution valves.
- I. Pre-Approved resilient wedge gate valves are as manufactured by: American Darling Valve Co., Birmingham, Alabama; Mueller Company, Decatur, Illinois; Clow Valve Division, Oskaloosa, Iowa; American AVK, Minden, NV; or Engineer approved equal.

2.02 VALVE BOXES

- A. Valve boxes shall be cast iron, 5-1/4" inside diameter, adjustable valve boxes of the screw type with sufficient length for the pipe bury as shown. Where the valve box is shown or required on control manholes, the length shall be sufficient to penetrate the valve marker and the Type II reinforced manhole cover. The cast iron cover of the valve box shall have an arrow indicating the direction of opening.
- B. Covers for water piping shall have the word "WATER" cast on the top.
- C. Pre-Approved valve boxes and covers are as manufactured by: Tyler Pipe Utilities Division, Tyler, Texas; Mueller Co., Decatur, Illinois; Clow Corporation, Oak Brook, Illinois; or Engineer approved equal.
- D. Each valve box shall be furnished with valve box centering adaptor compatible with the valve boxes furnished.
- E. The Contractor shall furnish one T-handled valve wrench to the owner that is compatible with the installed valves.

2.03 FLANGED AND MECHANICAL JOINT VALVES

- A. Valves located in non-bury locations shall be flanged style with 125 lb. ANSI flanged ends. Valves located in buried locations shall be mechanical joint type conforming to the requirements of ANSI Specification A21.11.

2.04 FASTENERS

- A. All fasteners in buried locations shall be Grade 304 (A2) or 316 (A4) stainless steel. Anti-Seize shall be applied to all threads prior to installation.

2.05 POLYETHYLENE WRAP

- A. All ductile fittings shall be wrapped with polyethylene plastic film having a minimum thickness of 0.008 inches or with a cross woven polyethylene plastic film having a minimum thickness of 0.004 inches.

PART 3 EXECUTION

3.01 VALVE INSTALLATION

- A. All valves shall be installed in locations as shown on the plans or as directed by the Owner's Resident Project representative.
- B. The valve and joints shall be installed in accordance with the manufacturer's recommendations.
- C. All pipe bevels shall be removed prior to installation of any valve or ductile iron fitting.

3.02 VALVE BOX INSTALLATION

- A. All foreign material and debris shall be removed from the top of the valve operator prior to setting the

valve box.

- B. Valve box centering device shall be installed to center valve box on valve.
- C. Valve boxes shall be centered and plumb over the operating nut of the valve and shall be set so that no shock or stress will be transmitted to the valve.
- D. Tops of the valve boxes shall be set flush with the valve identification collar or manhole cover unless otherwise directed.

* * * END OF SECTION * * *

SECTION 33 31 00 SANITARY SEWER PIPING AND FITTINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

- A. The general provisions of the Contract, including General and Supplementary Conditions shall apply to the Work covered in this section.
- B. Related Work Specified Elsewhere:
 - 1. Trenching, Backfilling and Compacting - Section 31 23 33
 - 2. Sanitary Sewer Gravity Pipe Cleaning - Section 33 01 30.12
 - 3. Standard Drawing: 33 31 00

1.02 DESCRIPTION OF WORK

- A. The work covered under these specifications shall include the furnishing of all labor, material, tools, and equipment necessary to furnish and install, complete in place, all piping and fittings as shown on the drawings and as specified herein.

1.03 SUBMITTALS

- A. The Contractor shall submit for review shop drawings for materials specified herein as hereinafter specified.
- B. Certificates from the manufacturer that the materials meet or exceed specified requirements.
- C. The manufacturer's installation recommendations, including types and amounts of gasket lubricant, where applicable, to be used.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. All materials shall be packed, loaded, transported, unloaded, and handled in such a manner so as to prevent damage to the materials.
- B. All material shall be loaded and unloaded by lifting with slings or hoists or skidding so as to avoid shock or damage. Dropping or rolling will not be permitted. The use of end hooks to install or move piping will not be allowed.
- C. All materials shall be stored on the site in accordance with the manufacturer's recommendations. Do not store materials directly on the ground.
- D. All materials shall be kept clean and dry. The insides of all piping and fittings shall be kept free of dirt and debris.

PART 2 PRODUCTS

2.01 DUCTILE IRON FITTINGS

- A. Ductile iron fittings shall conform to the requirements of ANSI/AWWA C110 & C153/A21.10 & A21.53.
- B. Ductile Iron Fittings to be installed underground shall be mechanical joint or push-on joint type conforming to the requirements of ANSI/AWWA C 111/A 21.11.
- C. Ductile Iron Fittings to be installed in "non-buried" locations shall be provided with flanged joints with rubber full-face gaskets. Flanged faces shall be drilled to standard 125-pound template unless otherwise noted.
- D. All Ductile Iron Fittings shall be lined with cement mortar in accordance with ANSI/AWWA C104/A21.4 the exterior finishes shall be an asphaltic varnish coating not less than 1 mil thick.

2.02 GRAVITY PVC PIPE

- A. Polyvinyl Chloride (PVC) gravity pipe shall be Type I, Grade I, conforming to the requirements of ASTM Specification D 3034 for Rigid Poly (Vinyl Chloride) Sewer pipe.
- B. Solvent Cement for PVC pipe joints shall conform to ASTM Specification ASTM D 2564 and shall be applied in conformance with ASTM D 2855. Solvent weld joints will be allowed on PVC cleanout risers only.
- C. Gasket type joints shall be made with rubber gaskets conforming to the requirements of ASTM F-477.
- D. The pipe shall be capable of withstanding trench loads imposed on it.

2.03 GRAVITY PVC PIPE FITTINGS

- A. Repair couplers, tees, wyes, and bends for Polyvinyl Chloride (PVC) gravity pipe fittings shall be of PVC with material and dimensions conforming to the requirements of ASTM Specification D 3034.
- B. Gaskets for elastomeric joints shall conform to the requirements of ASTM F-477.
- C. Solvent Cement for solvent weld joints shall conform to the requirements of ASTM Specification D 2564 and shall be applied in conformance with ASTM D 2855. Solvent weld joints will be allowed on PVC cleanout risers only.
- D. Sewer "Wyes" for service connections shall be in-line sewer wyes. Saddle wyes will not be permitted for use without permission from Project Engineer.

2.04 TRANSITION COUPLINGS (PRESSURE PIPING)

- A. The couplings used for transitions between pipings of different materials shall be a wide-range flexible coupler with a sleeve type design meeting the requirements of AWWA C219.
 - 1. The coupling body shall be a center sleeve fabricated of high strength carbon steel tubing equivalent to ANSI/AWWA C200. The transition couplers will be readily available in nominal diameter ranges from 1.5 to 24 inches on all pipe classes.
 - 2. Compression End Rings: One gasket compression end ring per coupling end. End rings to be of either one or two bolt design, fabricated of carbon steel equivalent to ASTM A576. (One bolt per end in Nominal Size ranges of 2 to 12 inches and two bolts per end on the 16 to 24 inch nominal diameter coupling.)

3. Hydraulic Wide Range Gasket: Chloramine Resistant NSF-61 approved EPDM gasket designed with a multi-layered wide range removable outer layer. Gasket hydraulically actuated with a pressure-equalizing dam, pressure cavity and sealing lip for working pressure of 260 psi (1.5 to 16 inches) and 232 psi (18 to 24 inch nominal diameter coupling).
 4. Fasteners shall be grade 304 (A2) or 316 (A4) stainless steel with yield strengths that conform to all nationally recognized standards. Bolts to be coated with an anti-seize type coating to prevent galling.
 5. The interior and exterior coatings shall NSF-61 approved fusion bonded epoxy coating conforming to AWWA C213.
 6. When properly installed the coupling will provide a minimum deflection of 8 degrees, up to 260 psi working pressure and 3/8 inch longitudinal pipe movement without leakage. (Flanged adapters will provide half the longitudinal movement and deflection.)
 7. All products will be proof tested to a minimum of 1.5 times working pressure.
- B. Flanged couplers shall consist of one compression end and gasket, coupling center sleeve, and AWWA Class "D" Flange (per AWWA C207).
- C. Pre-Approved transition couplers are: Hymax-2000 Series wide range coupling; Hymax-2100 Series wide range flanged coupling adapter; "Macro" extended range coupling by Romac Industries, Inc.; or Engineer approved equal.

2.05 TRANSITION COUPLINGS (GRAVITY PIPING)

A. GASKET

1. Manufactured to meet the material requirements of:
 - a. CSA B602 - mechanical couplings for drain, waste, vent pipe and sewer pipe
 - b. ASTM D 5926 - Standard Specification for Poly Vinyl Chloride (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems
 - c. ASTM C 1173 - Standard Specification for Flexible Transition Couplings for Underground Piping Systems
 - d. Hardness, Shore"A", Inst. ++5.....65
 - e. Tensile Strength, Min. psi1000
 - f. Elongation at Rupture, Min. %.....250
 - g. Tear Strength, Min..... 150 lb/in.
 - h. Brittleness Temperature..... -40°F

B. CLAMPS

1. Manufactured to the requirements of CSA B602
2. Clamp Housing- 301 Stainless Steel
3. Clamp Band - 301 Stainless Steel
4. Clamp Screw - 305 Stainless Steel
5. Installation torque 60" lbs

C. SHEAR RING

1. 0.012" Thick, 300 Series Stainless Steel
2. Width manufactured according to coupling width (1.50", 2.13", or 4")

3. Length manufactured according to coupling diameter
4. Clamps spot welded in place

D. COUPLING

1. Manufactured to conform to the performance requirements of:
 - a. ASTM C 1173 - standard specification for flexible transition couplings for underground piping systems
 - b. CSA B602 - mechanical couplings for drain, waste, vent pipe and sewer pipe
 - c. Maximum test pressure: 4.3 PSI (29.6KPA)
 - d. Maximum operating temperature: 140° F nonconsistent

E. Pre-Approved transition couplers are Strong Back RC Series Repair Couplings manufactured by Fernco Inc. or Engineer approved equal.

2.06 BEDDING MATERIAL

A. Borrowed granular bedding material shall conform to the gradation indicated below.

<u>Sieve Opening</u>	<u>Bedding Material (Percent Passing)</u>
1"	95-100
No. 200	< 15

B. Borrowed granular bedding material for unstable trench bottom shall conform to the gradation indicated of size 67 Course Aggregate, ASTM C33 which is indicated below.

<u>Sieve Opening</u>	<u>Bedding Material (Percent Passing)</u>
1-1/2"	100
3/4"	90-100
3/8"	20-55
No. 4	0-10
No. 8	0-5

C. Bedding material excavated from the job site shall be finely divided material free from organic material and clods, lumps of frozen material or stones larger than 1 1/2" in maximum diameter. Bedding material shall be of proper moisture content to form a firm bed for the pipe.

2.07 FASTENERS

A. All fasteners in buried locations shall be Grade 304 (A2) or Grade 316 (A4) stainless steel. Anti-Seize shall be applied to all threads prior to installation.

2.08 LUBRICANT FOR GASKETED PIPE

A. Lubricant shall be an emulsified polymer based product, specifically formulated to be water-soluble without causing turbidity. Lubricant shall not transfer taste and/or odor to new water main installations. Lubricant must not promote bacterial growth and be safe for use on all metal and plastic pipes. Lubricant shall be easily flushed from the line and be non-reactive to chlorinated water. Lubricant should work easily on both wet and dry surfaces.

2.09 POLYETHYLENE WRAP

A. All ductile fittings shall be wrapped with polyethylene plastic film having a minimum thickness of 0.008 inches or with a cross woven polyethylene plastic film having a minimum thickness of 0.004 inches.

PART 3 EXECUTION

3.01 GENERAL

- A. The areas to receive piping shall be examined for defects that may adversely affect the execution and quality of Work. Prior to the start of piping installation, all measurements shall be checked for deviations from allowable tolerances for piping.

3.02 BURIED PIPING INSTALLATION

- A. All piping and fittings shall be laid true to line and grade as shown on the plans. Each section of pipe shall be so laid and fitted together that when complete the piping will have a smooth uniform flow line. The inside of all pipe shall be cleaned before installation and kept thoroughly clean during and after the laying. Pipe ends shall be cleaned inside and outside.
- B. Apply lubricant liberally to the inside of the pipe bell and spigot. Make sure lubricated surfaces remain free of dirt, gravel, or other debris. Assemble the pipe joint immediately after application of the lubricant.
- C. All pipe and fitting shall be examined for defects before being lowered into the trench. The interior and exterior protective coating shall be inspected and field repaired, if required.
- D. The pipe shall be handled and installed in accordance with manufacturer's recommendations and the requirements of AWWA C 600 for Ductile Iron pipe, ASTM D 2774 for PVC pressure piping and ASTM D 2321 for PVC gravity sewer piping.
- E. When pipe laying is not in progress, including the noon hours, the open ends of pipe shall be closed. No trench water, animals, or foreign material shall be permitted to enter the pipe.
- F. Class "C" Bedding shall be used with all piping. The bedding material shall conform to the requirements of Part 2 above. General requirements for placement are shown on Standard Drawing 333100-1. On all non-rigid piping, care will be taken to provide maximum support in the haunch area of the pipe. This area extends from the bedding material to the center of the pipe. If coarse materials with voids have been used for bedding materials, the same bedding materials will be used for haunching. When a trench box or similar device is used during excavation, the box will be raised sufficiently to recompact the haunch area in the natural trench to 97% maximum dry density as determined by ASTM D 698.
- G. After each pipe has been graded, aligned, and placed in final position on the bedding material and shoved home, sufficient pipe embedment material shall be deposited and compacted under and around each side of the pipe and back of the bell or end thereof to hold the pipe in proper position and alignment during subsequent pipe joining and embedment operations.
- H. The pipe shall be laid upon properly placed bedding material so that the barrel of the pipe will have a bearing for its full length. No blocking will be allowed to bring the piping up to grade. Bell holes and depressions for joints shall be excavated after the trench bedding has been graded to provide uniform support for the entire pipe.
- I. The Contractor shall provide and maintain all necessary means and devices at all times to remove and dispose of all water entering the trench during the process of pipe laying. The trench shall be kept dry until the pipe laying and jointing are completed. Removal of water shall comply with Section 31 23 33.
- J. Thrust blocks or restraining fittings to restrain pressurized piping shall be provided at all abrupt changes in direction, tees, bends, dead ends and hydrants, and shall be in accordance with the pipe manufacturer's recommendations.
- K. The Contractor shall place backfill material in lifts not exceeding 1-foot and compact to 97% Standard Proctor Density. Stones equal to or larger than 3-inches in diameter shall not be placed within 2-feet of the pipe.

3.03 EXPOSED PIPING INSTALLATION

- A. Each item or system shall be furnished complete and installed as shown on the plans and in accordance with the manufacturer's recommendations, instructions, and directions. All installed equipment and systems shall be properly protected during subsequent construction operation.

- B. The Contractor shall inspect all material or equipment as it is received to determine damage and/or missing parts. It shall be his responsibility to repair or replace damaged items in accordance with the manufacturer's instructions.
- C. The Contractor shall provide all scaffolding required for the proper installation of this work in conformance with the standards of any local and state safety codes applying to scaffolding.
- D. All pipe shall be set such that the vertical and horizontal centerlines are properly aligned. Installation of piping by means of springing, forcing or stressing the pipe or adjacent fittings, valves or equipment will not be allowed.

3.04 MECHANICAL JOINTS AND COUPLINGS

- A. Mechanical joints shall be carefully assembled in accordance with the manufacturer's recommendations. If effective sealing is not obtained, the joint shall be disassembled, thoroughly cleaned, and reassembled or replaced. Over tightening bolts to compensate for poor installation practice will not be permitted.
- B. The holes in mechanical joints with tie rods shall be carefully aligned to permit installation of the tie rods. In flange and mechanical joint pieces, holes in the mechanical joint bells and the flanges shall straddle the top (or side for vertical piping) centerline. The top (or side) centerline shall be marked on each flange and mechanical joint piece at the foundry.

3.05 TRACER WIRE INSTALLATION

- A. Tracer wire shall be installed in the trench at the same time as the pipe or immediately prior to starting the backfill of the trench.
- B. Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.
- C. Splices will be allowed at manholes, bored crossings, and at other locations as agreed upon by the Resident Project Representative. Splices in tracer wire will be made with split bolt or compression-type connectors. Wire nuts may not be used. A waterproof connection is necessary to prevent corrosion. Splices shall be completed in accordance with the manufacturer's recommendations.
- D. Prior to final acceptance, all tracer wire shall be electrically tested for continuity from one exposed end to another.
- E. Bring the wire to the ground surface at each manhole and boring ends and loop the wire in a tracer wire terminal box. These boxes shall be located adjacent to the manhole and/or bored crossing in the boulevard with at least two feet of extra wire inside the box. The tracer wire terminal box must be installed flush with the finished grade.

3.06 TESTING

- A. All piping shall be cleaned and flushed after completion of installation.

* * * END OF SECTION * * *