



**TRAUTMAN
ASSOCIATES**

ARCHITECTS / ENGINEERS

TECHNICAL SPECIFICATIONS

Alden Green House

11580 Walden Ave
Alden, NY 14004

October 10, 2025
TA Project 24003

Trautman Associates
37 Franklin St., Suite 100
Buffalo, NY 14202

TRAUTMAN ASSOCIATES
11580 WALDEN AVE LLC
ALDEN GREEN HOUSE
TA PROJECT #24003

TECHNICAL SPECIFICATIONS

000101 Project Title Page
000110 Table of Contents

Division 01 – General Requirements

014110 Special Inspections and Testing Services Statement and Schedule of Special Inspections

Division 03 - Concrete

033000 Cast in Place Concrete

Division 05 - Metals

051200 Structural Steel Framing
053100 Steel Decking

Division 22 - Plumbing

220553 Identification for Plumbing Piping and Equipment
220586 Testing, adjusting, and balancing for plumbing
221316 Sanitary waste and vent piping
221319 Sanitary waste piping specialties
221319.13 Sanitary drains

Division 26 - Electrical

260500 Common Work Results for Electrical
260513 Medium-Voltage Cables
260526 Grounding and Bonding for Electrical Systems
260529 Hangers and Supports for Electrical Systems
260533 Raceway and Boxes for Electrical Systems
260543 Underground Ducts and Raceways for Electrical Systems
260553 Identification for Electrical Systems

Division 31 – Earthwork

311000 Site Clearing
312000 Earthmoving

Division 32 – Exterior Improvements

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ALDEN GREEN HOUSE
TA PROJECT #24003

321000	Paving
329000	Planting

Division 33 – Utilities

331000	Waterlines
333000	Sanitary Sewerage
334000	Storm Drainage

END OF SECTION 000110

Program of Structural Tests and Inspections
For compliance with the Building Code of New York State

Project: Alden Grow House
11580 Walden Ave
Alden, NY

Owner: 11580 Walden Ave LLC
4476 Main Street, Suite 204
Amherst, NY 14226

Architect: Trautman Associates
37 Franklin Street, Suite 100
Buffalo, NY 14202

Engineer: Tredo Engineers
755 Seneca Street, Suite 202
Buffalo, New York 14210

This program of structural test and inspection is submitted as a condition for issuance of the building permit in accordance with the Building Code of New York State.

The following firms, agencies, or individuals (hereinafter referred to collectively as agents), except for the Geotechnical Engineer, will perform the tests and inspections under the direction of the Special Inspector. (The Geotechnical Engineer is responsible for directing the testing and inspection of controlled structural fill, in-situ bearing stratum for footings, pile foundations, and pier foundations.)

<u>Abbreviation</u>	<u>Agent</u>
SER	Structural Engineer of Record listed above.
AOR	Architect of Record listed above.
SI	Special Inspector
OIAF	Owner’s Inspection Agency – Field
OIAP	Owner’s Inspection Agency – Plant
GE	Geotechnical Engineer
FQP	Fabricator’s Quality Control Program
CQP	Contractor’s Quality Control Program
NR	Not Required
NA	Not Applicable

The abbreviations will be used on the attached pages to identify which agent is performing the particular test or inspections.

Inspections and tests defined by these documents relate to work of permanent construction only. Temporary work or construction procedures such as shoring, scaffolding, trench supports, safety rails and nets, etc. are not included.

Reference attached form for the "Schedule of Special Inspection Services".

The following categories of structural tests and inspections, if checked, are included in the program for structural tests and inspections for this project. The specific tests and inspections required for each checked category are listed on the attached tables.

- ☒ 1705.2 - Steel Construction
- ☒ 1705.3 - Concrete Construction
- ☐ 1705.4 - Masonry Construction
- ☐ 1705.5 - Wood Construction
- ☒ 1705.6 - Soils
- ☐ 1705.7 - Driven Deep Foundations
- ☐ 1705.8 - Cast-in-place Deep Foundations
- ☐ 1705.9 - Helical Pile Foundations
- ☐ 1705.10 – Fabricated Items – reference individual categories and performance basis list below
- ☐ 1705.11 – Special Inspections for wind resistance is not applicable if the structure if V_{asd} (1609.3.1, 93 MPH) < 110 MPH for all exposures.
- ☐ 1705.12 - Special Inspections for seismic resistance

Design Spectral Response Acceleration at Short Periods, S_{DS} : 0.20 < 0.5

Building Height: < 30 ft

Seismic Force Resisting Systems and Response Modification Coefficient:

Pre-engineered Metal Building Frame System BY OTHERS.

Loading Dock Roof: Building Frame Systems:
Structural steel systems not specifically detailed for seismic resistance ($R = 3.0$)

Seismic Design Category B

☐ 1705.12 is applicable if the structure is:

1. Light Frame Construction, $S_{DS} > 0.5$ and Building Height is > 35-ft
2. Reinforced Concrete or Masonry, $S_{DS} > 0.5$ and Building Height is > 25-ft
3. One- or Two-Family Dwelling > 2-stories above grade plane

☐ 1705.12.1 – Structural Steel is applicable if assigned to SDC D or greater and R is > 3

☐ 1705.13.1 – Testing for Seismic Resistance is applicable if assigned to SDC D or greater and R is > 3

☐ 1705.12.2 – Structural Wood is applicable if assigned to SDC C or greater of fastener spacing is < 4-inches on center.

☐ 1705.12.3 – Cold-formed steel light-frame construction is applicable if assigned to SDC C or greater

The following items are excluded from this Program of Structural Tests and Inspections, since they are designed by other design professionals not under the control of the SER, and the SER was not retained to provide performance specifications for their design. Said design professionals must provide a Program of Structural Tests and Inspections for their respective designs.

- 1705.12.4 and 13.3 – Designated Seismic Systems
- 1705.12.5 and/or 13.2 – Architectural Components
- 1705.12.6 and/or 13.2 – MEP Components
- 1705.12.7 – Storage Racks
- 1705.12.8 and/or 13.4 – Seismic Isolation Systems
- 1705.12.9 – Cold-formed steel special bolted moment frames
- 1705.14 – Sprayed Fire Resistant materials
- 1705.15 – Mastic and intumescent fire-resistant coatings
- 1705.16 – Exterior Insulation and Finish Systems
- 1705.17 – Fire-resistant penetrations and joints
- 1705.18 – Testing for Smoke Control

The following items of construction, if checked, are specified in the structural plans or specifications on a performance basis. In accordance with the Building Code, their structural design will be reviewed by the SER and their construction is included in the Program for Tests and Inspections on the attached sheets.

- | | |
|---|---|
| ☐ Curtain Walls | ☒ Metal Buildings |
| ☐ Precast Concrete Components | ☐ _____ |
| ☐ Post Tensioning Steel | ☐ _____ |
| ☐ Structural Steel Connections | ☐ _____ |

The following items are excluded from the Program of Structural Tests and Inspections, since they are designed by other structural engineers not under the control of the SER, and the SER was not retained to provide performance specifications for their design. Said structural engineers must provide a Program of Structural Tests and Inspections for their respective designs.

Required Verification and Inspection of Steel Construction

Verification and Inspection	Agent	General Inspections		Seismic Inspections		Referenced Standard
		Periodic	Continuous	Periodic	Continuous	
1. Fabricator Certification / Quality Control Procedures / Inspection: Verify that each Fabricator maintains a complete, accurate, and detailed fabrication and quality control procedure evaluated relative to the Code requirements and Fabricator's scope of work. Inspections of plant are to be made based on these programs.	SER OIAP FQP	X				BCNYS 1704
2. Material verification of high-strength bolts, nuts, and washers: a. Identification markings to conform to ASTM standards specified in the approved construction documents. b. Manufacturer's certificate of compliance required.	OIAP OIAF FQP CQP	X				Applicable ASTM material specifications; AISC ASD, Section A3.4; AISC LRFD, Section A3.3
3. Inspection of high-strength bolting: a. Bearing-type connections. b. Slip-critical connections. c. Anchor bolts Inspect: 1. Size 2. Type 3. Geometry 4. Projection 5. Washers 6. Nuts 7. Nut engagement 8. Tightness	OIAF CQP	X X X				AISC LRFD Section M2.5 BCNYS 1705
4. Material verification of structural steel: a. Identification markings to conform to ASTM standards specified in the approved construction documents. b. Manufacturers' certified mill test reports.	OIAP FQP OIAP SER	 X	X			ASTM A 6 or ASTM A 568 ASTM A 6 or ASTM A 568 BCNYS 1705
5. Material verification of weld filler materials: a. Identification markings to conform to AWS specification in the approved construction documents. b. Manufacturer's certificate of compliance required.	OIAF OIAP FQP CQP SER	X				AISC, ASD Section A3.6; AISC LRFD Section A3.5

Verification and Inspection	Agent	General Inspections		Seismic Inspections		Referenced Standard
		Periodic	Continuous	Periodic	Continuous	
6. Inspection of welding: a. Structural steel: 1. Complete and partial penetration groove welds. 2. Multi-pass fillet welds 3. Single-pass fillet welds > 5/16" 4. Single-pass fillet welds < 5/16" 5. Floor and deck welds. 6. Welded studs used for structural diaphragm: a. Inspect for size and placement. b. Hammer test. c. Visually inspect weld. 7. Ultrasonic testing of base metal > 1.5" thick. b. Reinforcing steel: 1. Verification of weldability of reinforcing steel other than ASTM A 706. 2. Reinforcing steel-resisting flexural and axial forces in intermediate and special moment frames, and boundary elements of special reinforced concrete shear walls and shear reinforcement. 3. Shear reinforcement. 4. Other reinforcing steel.	OIAP OAIF FQP CQP	X X X N/A N/A	X N/A N/A N/A N/A			AWS D1.1, BCNYS 1704.3.1 AWS D1.3, AWS D1.4, ACI 318:3.5.2 BCNYS 19 AISC Seismic, AWS D1.1, ASTM A 435 or A 898 Level 1
7. Inspection of steel frame joint details for compliance with approved construction documents: a. Details such as bracing and stiffening. b. Member locations. c. Application of joint details at each connection. d. Inspect size, grade of steel, camber, etc.	OIAP OAIF FQP CQP	X				BCNYS 1705
8. Inspect open web steel joists for: a. Size b. Placement (spacing) c. Bearing elevation and length d. Connections to structure e. All welds on a minimum of 5% of joists, randomly selected	OIAF CQP	X				BCNYS 1705
9. Inspect metal floor and roof decks for: a. Gage b. Width c. Type d. Welds per Item 6.a.5 e. Sidelap connections f. Screws and other fasteners	OIAF CQP	X				BCNYS 1705

Required Verification and Inspection of Concrete Construction

The following program of Special Inspections is for all concrete present on this project **EXCEPT** the following items:

1. Isolated Footings
2. Continuous Footings and Frost Walls (continuously supported walls under 4'-0" tall)
3. Non-Structural Slabs-on-Grade
4. Patios, Driveways, Sidewalks on Grade

Verification and Inspection	Agent	General Inspections		Seismic Inspections		Referenced Standard
		Periodic	Continuous	Periodic	Continuous	
1. Inspection of reinforcing steel, including prestressing tendons. i. Grade size ii. Quantity iii. Location iv. Condition v. Cover vi. Supports vii. Inspect damage to epoxy coating. viii. Inspect mechanical splices and grouted dowels.	OIAF CQP	X				ACI 318: 3.5, 7.1 – 7.7 BCNYS 19 Reference Tredo Engineers Specification Section 01410-Testing Services for minimum concrete testing.
2. Inspection of reinforcing steel welding in accordance with Steel Inspections, Item 5B.	OIAF CQP		N/A			AWS D1.4, ACI 318: 3.5.2 BCNYS 19
3. Inspect bolts to be installed in concrete prior to and during placement of concrete where allowable load have been increased.			N/A			BCNYS 19
4. Verifying use of required design mix. Review: i. Materials ii. Admixtures iii. Curing methods	SER OIAF CQP OIAP FQP	X X				ACI 318: Ch. 4, 5.2-5.4 BCNYS 19 Reference Tredo Engineers Specification for Special Inspection and Testing Services for minimum concrete testing.
5. Sampling fresh concrete and performing slump, air content and determining the temperature of fresh concrete at the time of making specimens for strength tests.	OIAF CQP	X				ASTM C 172, ASTM C 31, ACI 318: 5.9, 5.10 BCNYS 19

Verification and Inspection	Agent	General Inspections		Seismic Inspections		Referenced Standard
		Periodic	Continuous	Periodic	Continuous	
6. Inspection of concrete and shotcrete placement for proper application techniques. Review plant quality control procedures and batching and mixing methods.	SER OIAP FQP	X X				ACI 318: 5.9, 5.10 BCNYS 19
7. Inspection for maintenance of specified curing temperature and techniques. i. Observe methods of moisture retention and form removal. ii. Concrete cylinders – perform verification testing as directed.	OIAF CQP	X				ACI 318: 5.11-5.13 BCNYS 19 Reference Tredo Engineers Specification for Special Inspection and Testing Services for minimum concrete testing.
8. Inspection of prestressed concrete: a. Inspect tensioning and anchorage of tendons. b. Inspect damage to strand sheaths. c. Grouting of bonded prestressing tendons in the seismic-force-resisting system.	OIAF CQP		N/A			ACI 318: 18.18, 18.16.4
9. Erection of precast concrete members.	OIAF CQP	N/A				ACI 318: Ch. 16
10. Verification of in-situ concrete strength, prior to stressing of tendons in posttensioned concrete and prior to removal of shores and forms from beams and structural slabs.	OIAF CQP	N/A				ACI 318: 6.2 BCNYS 19
11. Formwork geometry: Inspect form dimensions and tightness. Inspect surfaces and tie type and layout for architectural concrete.	OIAF CQP	X				

Required Verification and Inspection of In-Situ Bearing Strata for Footings and Foundation Mats and Controlled Structural Fill

Verification and Inspection	Agent	General Inspections		Seismic Inspections		Referenced Standard
		Periodic	Continuous	Periodic	Continuous	
1. Bearing strata Inspect strata for conformance to the contract drawings, specifications, and/or geotechnical report.	GE	X				BCNYS 1705
2. Bearing surfaces a. Inspect bearing surfaces for conformance to the required soil bearing capacity. b. Inspect water control and surface protection methods.	GE	X				BCNYS 1705
3. Fill material a. Test material for conformance to specifications or geotechnical report. b. Perform laboratory compaction tests in accordance with the specifications to determine optimum water content and maximum dry density.	OAIF or GE	X				BCNYS 1705
4. Installation of controlled structural fill Provide full time inspection of the installation in accordance with the specifications.	OIAF or GE	N/R if lifts < 12"				BCNYS 1705
5. Density of fill Perform field density tests of the in-place fill in accordance with the specifications.	OIAF or GE	X				BCNYS 1705
6. Caissons a. Inspect caisson excavation and concreting operations. b. Monitor sediment content of water pumped out of the caissons. c. Prepare caisson field report.	GE	N/R				BCNYS 1705
7. Piles a. Be present for installation and load test of piles. b. Submit report of installation, load test results, cutoff and tip elevations.	GE OIAF		N/A N/A			BCNYS 1705

Prepared by the Structural Engineer of Record.

Date:_____

Name: Matthew Etu

Affix Seal

Tredo Engineers

Statement of Special Inspections

Project: Alden Grow House
11580 Walden Ave
Alden, NY

Owner: 11580 Walden Ave LLC
4476 Main Street, Suite 204
Amherst, NY 14226

Architect: Trautman Associates
37 Franklin Street, Suite 100
Buffalo, NY 14202

Engineer: Tredo Engineers
755 Seneca Street, Suite 202
Buffalo, New York 14210

This Statement of Special Inspections is submitted as a condition for permit issuance in accordance with the Special Inspection requirements of the Building Code. It includes a Schedule of Special Inspection Services applicable to this project and identifies the special inspection agent intended to conduct these inspections. The Architect and Structural Engineer of Record is **not** performing the duties of the “**Special Inspector**” as defined in Section 17 of the New York State Building Code. The **Special Inspector is a separate agency** retained by the Owner to perform the duties required by the New York State Building Code.

The Special Inspector shall keep records of all inspections and shall furnish inspection reports to the Building Official, Structural Engineer, and Architect of Record. Discovered discrepancies shall be brought to the immediate attention of the Contractor for correction. If such discrepancies are not corrected, the discrepancies shall be brought to the attention of the Building Official, Structural Engineer, and Architect of Record. The Special Inspection program does not relieve the Contractor of his or her responsibilities.

Interim reports shall be submitted to the Building Official, Owner, Structural Engineer, and Architect of Record at a frequency to be agreed upon by Special Inspector and Building Code Official.

A Final Report of Special Inspections documenting completion of all required Special Inspections and correction of any discrepancies noted in the inspections shall be submitted at the completion of construction.

Job site safety and means and methods of construction are solely the responsibility of the Contractor.

Prepared by:

Tredo Engineers Date

Architect of Record

Signature Date

Special Inspector:

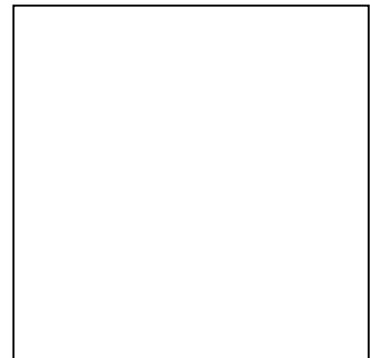
Signature Date

Owner’s Authorization:

Signature Date

Building Official’s Acceptance:

Signature Date



Design Professional Seal

Schedule of Special Inspection Services

Inspection Agents	Qualifications / Certifications
Special Inspector: Name: _____ Address: _____ Phone: _____	Reference attached "Statement of the Special Inspector"
Soils / Geotechnical Engineer (GE): Firm Name: _____ Address: _____ Phone: _____ Testing Agency / Laboratory Directed by Geotechnical Engineer: Firm Name: _____ Address: _____ Phone: _____ Inspectors Name: 1. _____ 2. _____ 3. _____	1. _____ 2. _____ 3. _____
Owner's Inspection Agency – Field (OIAF) A. Steel Construction: Firm Name: _____ Address: _____ Phone: _____ Inspectors Name: 1. _____ 2. _____ 3. _____ B. Concrete Construction: Firm Name: _____ Address: _____ Phone: _____	1. _____ 2. _____ 3. _____

Contractor's Quality Control Program (CQP)	
A. Steel Construction:	
Firm Name: _____	
Address: _____	
Phone: _____	
Inspectors Name:	
1. _____	1. _____
2. _____	2. _____
3. _____	3. _____
B. Concrete Construction:	
Firm Name: _____	
Address: _____	
Phone: _____	
Inspectors Name:	
1. _____	1. _____
2. _____	2. _____
3. _____	3. _____
C. Soils Testing Agency / Laboratory:	
Firm Name: _____	
Address: _____	
Phone: _____	
Inspectors Name:	
1. _____	1. _____
2. _____	2. _____
3. _____	3. _____

Note: The inspection and testing agent shall be engaged by the Owner or the Owner's Agent, and not by the Contractor or Sub-Contractor whose work is to be inspected or tested. Any conflict of interest must be disclosed to the building official, prior to commencing work.

Qualifications of Inspectors and Testing Technicians

The qualifications of all personnel performing Special Inspection activities are subject to the approval of the Building Official. The credentials of all Inspectors and testing technicians shall be provided if requested.

Key for Minimum Qualifications of Inspection Agents:

When the Special Inspector deems it appropriate that the individual performing a stipulated test or inspection have a specific certification or license as indicated below, such designation shall appear below the Agent Number on the Schedule of Special Inspections.

SE	Structural Engineer – a licensed professional engineer specializing in the design of building structures.
GE	Geotechnical Engineer – a licensed professional engineer specializing in soil mechanics and foundations.
EIT	Engineer-In-Training – a graduate engineer who has passed the Fundamentals of Engineering examination.
ACI	American Concrete Institute – Level I Certified Concrete Field Testing Technician – individuals certified to perform concrete sampling, slump tests, air-content tests, temperature tests, unit weight tests, and casting compression test cylinders. American Concrete Institute – Level II Certified Concrete Field Testing Technician –
AWS	American Welding Society – Certified Welding Inspector (CWI) – individuals certified to perform visual inspections of welds.
ASNT	American Society of Non-Destructive Testing Level II or III – individuals certified to perform ultra-sonic testing of welds.
SMSI	Structural Masonry Special Inspector – certification by ICBO.
SWSI	Structural Steel and Welding Special Inspector – certification by ICBO.
SFSI	Spray-Applied Fireproofing Special Inspector – certification by ICBO.
PCSI	Prestressed Concrete Special Inspector – certification jointly sponsored by ICBO, BOCA, and SBCCI with participation form PCI and PTI.
RCSI	Reinforced Concrete Special Inspector – certification jointly sponsored by ACI, ICBO, BOCA, and SBCCI.

SECTION 014110 – SPECIAL INSPECTIONS AND TESTING SERVICES

PART 1 - GENERAL

1.01 RELATED REQUIREMENTS SPECIFIED ELSEWHERE:

- A. Inspections and testing required by laws, ordinances, rules, regulations or orders of public authorities.
- B. Certifications of materials, products or equipment: Respective Specifications Sections.
- C. Test of materials, adjust and balance of products or equipment: Respective Specification Sections.

1.02 GENERAL REQUIREMENTS

- A. Provide special inspections and testing in accordance with Chapter 17 of the Building Code of New York State
- B. The program of Special Inspections and Testing is a Quality Assurance program intended to ensure that the work is performed in accordance with the Contract Documents.
- C. This specification section is intended to inform the Contractor of the Owner's quality assurance program and extent of the Contractor's responsibilities. This specification section is also intended to notify the Special Inspectors, Testing Laboratories, and other Agents of the Special Inspectors of their requirements and responsibilities.

1.03 SCHEDULE OF INSPECTIONS AND TESTS

- A. Required inspections and tests are described in the attached Statement of Special Inspections and in the individual specification sections for the items to be inspected or tested.
- B. The services and quantities of testing specified are approximate and may vary. Actual services and quantities of testing will be determined by the Owner and/or Architect and Construction Manager during the construction period.
- C. The Architect and Construction Manager will determine the locations for taking sample specimens for testing in accordance with the specifications.

1.04 EMPLOYMENT OF SPECIAL INSPECTOR AND AGENTS:

- A. Special Inspectors must demonstrate, to the Engineer of Record and Building Official's satisfaction, experience and skills to satisfactorily conduct testing indicated without delaying the progress of the work.
- B. The Owner will employ and pay for the services of the Special Inspector's to perform the services specified herein; however, the Contractor shall reimburse the Owner for the cost

of those services which, in the opinion of the Architect/Engineer (and Construction Manager), are required due to the following:

1. Failure of materials or workmanship to meet contract requirements.
 2. Materials or practices, not complying with the Specifications which could possibly result in defective work thereby rendering it necessary or advisable to perform tests to determine whether or not work is acceptable.
 3. Changes in source, quality or characteristics of materials.
 4. Site cured cylinders requested by the Contractor.
- C. The Special Inspector shall retain the services of a full time registered Professional Engineer who shall certify all test reports. The Engineer shall be responsible for the training of the testing technicians and shall be in responsible charge of the field and laboratory testing operations.
- D. Special inspections shall be performed by Special Inspectors who are certified as identified below, or are working under the direction of a registered Professional Engineer.
1. Technicians performing sampling and testing of concrete shall be ACI certified Concrete Field Testing Technicians – Grade 1.
 2. Inspectors performing inspections of concrete work such as inspections of concrete placement, batching, reinforcing placement, curing and protection, shall be ACI certified Concrete Construction Inspectors or ICBO certified Reinforced Concrete Special Inspectors.
 3. Technicians performing visual inspection of welding shall be AWS Certified Welding Inspectors or ICBO certified Structural steel and Welding Special Inspectors; technicians performing non-destructive testing such as ultrasonic testing, radiographic testing, magnetic particle testing, or dye-penetrant testing shall be certified as an ASNT-TC Level II or Level III technician.
 4. Technicians performing standard tests described by specific ASTM Standards shall have training in the performance of such tests and must be able to demonstrate either by oral or written examination competence for the test to be conducted. They shall be under the supervision of a licensed Professional Engineer and shall not be permitted to independently evaluate test results.

1.05 CONTRACTOR'S RESPONSIBILITIES

A. COOPERATION AND ACCESS:

1. Cooperate with laboratory personnel and provide access to the work and to manufacturers. Fabricator's facilities as required for the performance of their services.

2. Retain the latest set of construction drawings, field sketches, approved shop drawings, and specification at the project site for use by the inspectors and testing technicians.

B. CASUAL LABOR AND FACILITIES:

Provide Casual Labor and Facilities:

1. To provide access to the work to be inspected or tested.
2. To obtain and handle samples at the site.
3. To facilitate inspections and tests.
4. To construct a storage box on the site of sufficient size to store cylinders, which will afford protection, required by ASTM C-31.

C. SAMPLES:

1. Provide the laboratory with preliminary representative samples of materials to be tested, in requested quantities.
2. When the source, quality or characteristic of an approved material changes or indicates lack of compliance with contract requirements, submit additional samples of materials to testing laboratory.

D. MISCELLANEOUS REPORTS, LISTS, ETC.:

1. When requested by the Architect/Engineer, or the testing laboratory, the Contractor shall immediately provide copies of mill reports, cutting lists, material bills, shipping bills, time and place of shipment of materials to shop and field and any relevant data on previous testing and investigations of materials.

E. NOTIFICATION:

1. Review the Statement of Special Inspections and be responsible for coordinating and scheduling inspections and tests to facilitate the timely sequence of inspection and testing, the Contractor shall give advanced notification to the testing laboratory and the Architect/Engineer (and Construction Manager) that work has progressed to a point where inspection and testing may proceed.
2. Advanced notification, shall be 48 hours (min.) prior to commencement of the following:
 - a. Site Preparation
 1. Excavation for foundations and slab on grade.

2. Proof-rolling of slab on grade subgrade.
- b. Soil Compaction:
 1. Delivery of fill to the site.
 2. Placement and compaction of fill or backfill.
- c. Concrete:
 1. Setting of reinforcing and formwork.
 2. Placing concrete.
- d. Structural Steel and Pre-Engineered Metal Building Structure:
 1. Shop fabrication (Structural Steel Only)
 2. Delivery.
 3. Erection.
 4. Alignment and leveling of structure.
 5. Welding and bolting of connections.
- e. Metal Deck:
 1. Delivery.
 2. Erection and fastening to structure.

F. CONTRACTOR'S QUALITY CONTROL:

1. The Special Inspection program does not, in any way, relieve the Contractor of his obligation to perform work in accordance with the requirements of the Contract Documents or from implementing an effective Quality Control program. All work that is to be subjected to Special Inspections shall first be reviewed by the Contractor's quality control personnel.
2. Services of testing laboratory retained by the Owner is for verification of Contractor's compliance and if such tests of inspection indicates failure to comply with the Contract Documents, the Contractor shall bear all cost associated with additional testing and inspection, after the work has been corrected, to verify compliance.

G. PATCHING:

Areas where samples are taken for purposes of testing shall be patched to the satisfaction of the Architect.

1.06 LIMITS ON AUTHORITY

- A. The Special Inspectors or Testing Laboratories may not release, revoke, alter, or enlarge on the requirements of the Contract Documents.
- B. The Special Inspectors or Testing Laboratories will not have control over the Contractor's means and methods of construction.
- C. The Special Inspectors or Testing Laboratories are not responsible for construction site safety.
- D. The Special Inspectors or Testing laboratories have no authority to stop the work.

1.07 STATEMENT OF SPECIAL INSPECTIONS

- A. The Engineer of Record (EOR) will prepare the Statement of Special Inspections.
- B. Submit the Statement of Special Inspections with the application for Building Permit.

1.08 RECORDS OF REPORTS

- A. Submit Bi-Weekly reports of each inspection or test to the registered design professional in responsible charge. Reports shall include:
 - 1. Date of test or inspection.
 - 2. Name of inspector or technician.
 - 3. Location of specific areas tested or inspected.
 - 4. Description of test or inspection and results.
 - 5. Applicable ASTM standard.
 - 6. Weather conditions.
 - 7. Signature of special inspector or technician.
- B. Submit interim reports to the Building Official which include all inspections and test reports received that week. Provide copies to the Architect, and Contractor. The frequency of the interim reports shall be as required by the Township.

- C. Any discrepancies from the Contract Documents found during a Special Inspection shall be immediately reported to the Contractor. If the discrepancies are not corrected, the Special Inspector shall notify the EOR and Building Official. Reports shall document all discrepancies identified and the corrective action taken.
- D. The Testing laboratory shall immediately notify the registered design professional in responsible charge by telephone or fax of any test results which fail to comply with the requirements of the Contract Documents.
- E. Provide a statement to the registered design professional in responsible charge at the completion of the work requiring Special Inspections from each inspection agency and testing laboratory that all work was completed in substantial conformance with the Contract Documents and that all appropriate inspections and tests were performed.

1.09 FINAL REPORT OF SPECIAL INSPECTIONS

- A. Complete Final Report of Special Inspections by the registered design professional in responsible charge and submit to the EOR and Building Official prior to the issuance of a Certificate of use and Occupancy.
- B. Use C.A.S.E. Form 102 – 2001 for the Final Report of Special Inspections.
- C. The Final Report of Special Inspections will certify that all required inspections have been performed and will itemize any discrepancies that were not corrected or resolved.

1.10 SUBMITTALS:

- A. The Special Inspectors and Testing Laboratories shall submit to the EOR and Building Official for review a copy of their qualifications which shall include the names and qualifications of each of the individual inspectors and technicians who will be performing inspections or tests.
- B. The Special Inspectors and Testing Laboratories shall disclose any past or present business relationship or potential conflict of interest with the Contractor or any of the Subcontractors whose work will be inspected or tested.
- C. Submit three copies of the following:
 - 1. Reports of all tests performed on soils, concrete, pre-engineered metal building deck, and paving.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 FREQUENCY OF INSPECTIONS

- A. Shall conform to the attached program of Special Inspections.

B. Definitions:

1. Periodic – In general, no more than a half day site visit, not less than 48 hours apart, unless otherwise directed by Owner, Architect, or Engineer, or specified below.
2. Continuous – In general, the Special Inspector or Agent should be on site before, during, and after operation requiring inspection.

3.02 EXISTING SUBGRADES

A. Field Verification

- a. Observe proofrolling operations.
- b. Identify location and extent of soft, loose, or yielded subgrade material that must be removed or undercut.
- c. Inspect undercut subgrade.

3.03 SOILS:

A. Laboratory Tests:

1. Existing site material
 - a. Cohesive soils and semi-cohesive soils: Provide one optimum moisture-maximum density curve for each type of subgrade soil encountered in accordance with ASTM D-1557.
 - b. Non-Cohesive soils: Provide maximum and minimum index densities and relative densities for each type of subgrade soil encountered in accordance with ASTM D-4254.
2. Borrow materials: Analyze each type of borrow materials before acceptance and delivery to the site. Any change in the source or quality of the material will require a new series of tests to determine acceptability.
 - a. Particle size analysis of soils ASTM D-422, ASTM D-421, ASTM D-420, ASTM C-117 recommended practice.
 - b. Plasticity index determination ASTM D-4318.
 - c. Moisture-density curve determination ASTM D-1557 or relative density (ASTM D-4253 or ASTM D-4254) as specified above.
 - d. Frost susceptibility analysis.

B. Field Tests:

1. The Owner's soils testing agency representative shall be present during delivery and compaction of fill materials.
2. Establish suitable bearing grades for foundations and structural fill below slabs on grade.
3. Verify natural soil and structural fill subgrades for all slabs on grade.
4. In-place density tests: Test in accordance with ASTM D-1556 (sand cone method) or ASTM D-2922 (nuclear method) on compacted natural soils or structural fill materials as follows:
 - a. One test for each 2000 sq. ft. of slab on grade and pavement subgrade per 12" lift.
 - b. One test for each 200 cu. yd. of fill and backfill at exterior side of foundation walls and unpaved areas.
5. Verify and monitor compaction operations and equipment.
6. Monitor proof-rolling operations for foundation and slab-of-grade subgrades.

3.04 CONCRETE:

A. Sampling:

1. Concrete samples shall be taken in accordance with ASTM C-172 "Sampling Fresh Concrete".
2. Inspection/Testing proposed materials.
3. Aggregate Analysis.
4. Conduct compression tests to verify that design mix complies with Contract Documents.

B. Formwork and Reinforcing:

1. Inspect formwork and reinforcing prior to placing of concrete.

C. Batching Inspection:

1. Inspect batching, mixing and delivery operations for compliances with the Specifications.

D. Compressions Tests:

1. Label each compression test cylinder identifying the truckload of concrete from which sample was taken and the exact location in construction where deposited.
2. Test specimens in accordance with ASTM C-39 "Methods of Tests for Compressive Strength of Molded Concrete Cylinders". Include weight test.
3. One compression test, as used herein shall consist of 3 test cylinders made from composite samples secured from a single truckload of concrete.
4. Break 1 test cylinder at 7 days and the remaining 2 at 28 days. If desired by the architect, engineer, or construction manager a fourth test cylinder can be made and held for 56 days.

E. One compression test will be required for each of the following conditions:

1. Each 50 cu. yd. of concrete or fraction thereof.
2. Each class of concrete placed in one day.

F. Slump Tests:

1. Slump test shall be made in accordance with ASTM C-143 "Methods for Slump of Portland Cement Concrete".
2. Test Slump of concrete at same frequency and from same truckload as compression tests and more often when directed by the Owner's representative.

G. Air Content Tests:

1. Determine air content by ASTM C-231 "Method of Test for Air Content of Freshly Mixed Concrete by the Volumetric Method".
2. Determine air content at same frequency and from same truckload as for compression tests.

3.05 STRUCTURAL STEEL

A. Shop Testing and Inspection:

1. Verify and monitor all welder qualifications, welding procedures and welding processes.
2. Monitor fabrication operations.
3. Review all mill reports.

4. Visually inspect and measure weld profiles, at random, prior to application of paint.
5. Review Shop Quality Control Manual and Procedures with shop foreman.

B. Field Testing and Inspection:

1. Visual inspection:
 - a. Verify and monitor welder qualifications and welding processes.
 - b. Inspect field erection of structural elements.
 - c. Inspect field bolting operations.
 - d. Inspect field welding operations.
 - e. Inspect anchor bolt installation and tightening.
2. High Strength Bolted Connections
 - a. Test all bolted connections for conformance with the AISC "Specification for Structural Joints using ASTM A325 or A490 Bolts", 2000 edition.
3. Magnetic Particle Testing
 - a. Test 5% of field fillet welds, at random, final pass only for conformance with ASTM E709 and ASTM E1444.
4. Ultrasonic Testing
 - a. Test 100% of all field partial and full penetration welds, at random, for conformance with ASTM E164 and AWS D1.1.

3.06 METAL DECKING

A. Visual Inspection

1. Verify and monitor welder's qualifications and welding processes.
2. Inspect field erection procedures for metal decking.

3. Inspect field welding operations.
4. Inspect mechanical fastening operations.

END OF SECTION 014110

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. Testing Laboratory Services: Section 014110.

1.02 QUALITY ASSURANCE

- A. Welder's Qualifications:

1. Qualifications of welders shall be as prescribed in the "Standard Qualification Procedures" by the American Welding Society.
2. Welding operators shall have been previously qualified to perform the type of work required for this project.

- B. Reference Standards:

Unless otherwise indicated herein, perform work in accordance with the following standards:

1. Steel Deck Institute: "Code of Recommended Standard Practice".
2. American Welding Society: "Code for Welding in Building Construction".
3. American Iron and Steel Institute: "Specifications for the Design of Light Gauge Cold-Formed Steel Structural Members".
4. Factory Mutual: Loss Prevention Data 1-28 Insulated Steel Deck.

1.03 SUBMITTALS

- A. Shop Drawings:

1. Indicate all details of fabrication and installation.
2. Deck: Include type, gauge, finish, location, openings, dimensions, anchorage details, lap details, accessories and shoring requirements (if any).
3. Shear Connectors: Include type, number, location, typical details and welding data.

- B. Product Data:

1. For each type of Deck.

C. Certification:

1. Evidence of welders qualifications.
2. Certifications from an approved independent Testing Laboratory indicating compliance with specified fire resistance requirements.

1.04 STORAGE AND HANDLING

- A. Do not store deck in direct contact with ground.
- B. Do not damage deck during handling.
- C. If mud, dirt or other foreign matter does accumulate on the deck, completely remove such accumulation prior to erection.

PART 2 - PRODUCTS

2.01 DESIGN

- A. Span each deck unit over 3 or more spans, minimum load capacity equivalent to SDI Standard Load Tables.
- B. Where deck spans less than 3 spans, increase the gauge of the deck to provide the same load capacity as shown in SDI Standard Load Tables for 3 or more spans.

2.02 A. Acceptable Products:

1. Type 1.5B by Vulcraft Div. Nucor Corp.
2. Type B by New Millenium Building Systems
3. Type B by Canam Steel Corporation

B. Material:

1. Steel Sheet, ASTM A611 with a minimum yield strength of 33,000 PSI.
2. Physical Properties:
 - a. Depth 1-1/2"
 - b. Per plan

C. Fire Resistance Requirements:

Comply with "FM Loss Prevention Data 1-28" for attaching deck.

D. Finish:

Protect with a zinc coating conforming to ASTM A-525 coating designation G60.

2.03 ACCESSORIES

- A. Roof Sump Plates: 24" square, minimum 20 gauge flat sump pan, required at each roof drain where metal deck is to receive rigid insulation.
- B. Closures:
 - 1. Metal Closures: Minimum 20 gauge steel with same finish as adjacent deck.
 - 2. Flexible Closure Strips: Rubatex by Rubtex Corporation, or approved equal and shall conform to profile of various decks as required.

2.04 FIELD TOUCH-UP (Galvanized Surfaces)

- A. Acceptable Products:
 - 1. Z.R.C. Cold Galvanizing Compound by Z.R.C. Chemical Products Company.
 - 2. Zinc clad 5 primer by Sherwin Williams Company.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Prior to proceeding with installation of deck, the following shall have been completed:
 - 1. Related steel framework plumbed, aligned and completed.
 - 2. Temporary shoring installed (if required).
 - 3. Ice, oil, dirt, rust, and other materials which may adversely affect welding shall have been removed.

3.02 INSTALLATION

- A. Placing Deck Units:
 - 1. Position metal deck units on supporting steel and accurately align to final position with units resting tightly on top of all supporting members. Do not stretch or contract the side lap interlocks.
 - 2. Minimum bearing on steel supporting members shall be 2".
 - 3. Minimum end laps shall be 2".
 - 4. Center ends of deck over center of supports.

B. Cutting and Fitting:

1. Shop Cutting: Cut to proper length before shipping to the field.
2. Field Cutting By Metal Deck Erector:
 - a. Notch to fit around columns and other similar fabrication.
 - b. All holes and openings which are located and dimensioned on the structural drawings.
 - c. Holes in deck larger than 6" and up to 12" in diameter:
 1. Deck erector shall furnish and install 1-1/2" x 1-1/2" x 3/16" galvanized steel angle 5'-0" long on one or both sides of each hole, perpendicular to flutes, as required. (Both sides if any portion of hole occurs in middle 1/3 of deck span, otherwise one side.)
 2. Attach angle to underside of deck by bolting or puddle welding at each bottom flute.
 3. Do not space holes closer than 5'-0" on center in any span.
3. Field Cutting By Other Trades:
 - a. Holes and openings required for work under other Sections of the Specifications, which are not located and dimensions on the structural drawings and are 6" in diameter or less shall be cut by the respective trade. Not more than one rib shall be cut per panel per span.
 - b. Method and Quality of Cutting: All cuts shall be neat and trim in appearance, cut deck with metal saw, drills or cutting torch.

C. Closures:

1. Provide metal closures for all openings in composite metal deck 1/16" wide and over, including the following:
 - a. Cover plate to close panel edge and end conditions and where panels change direction or abut.
 - b. Column closures to close openings between metal deck and structural steel columns.
 - c. Where deck is cut for passage of pipes, ducts, columns, etc. and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck.

SECTION 033000 –CAST IN PLACE CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Furnish all labor, material and equipment necessary to complete all cast-in-place concrete, reinforcement, formwork, and related work.

1.02 SUBMITTALS

A. Submit 3 copies of the following:

1. Shop Drawings

- a. Bar reinforcement shop drawings shall include setting plans, wall elevations, bending diagrams, cutting lists, and other information so as to completely and unambiguously define and establish the location, spacing, size, length, bending, shape, splicing, keying at construction joints and all other pertinent information as required. Drawings shall show grades of reinforcing steel. Opposite hand reinforcing shall be detailed separately. Wall reinforcing shall be detailed on wall elevations. Each shop drawing shall show splice length for every size and type of bar used.
- b. Type, size and location of all accessories required for the proper assembling, placing and support of the reinforcement.
- c. All openings, depressions, construction and control joints, trenches, sleeves, inserts and all other project requirements affecting reinforcing details and placing.
- d. Placement drawings indicating joint layout, types, location, and dimensions for the following:

1. Slabs on Grade

2. Walls

B. Manufacturer's Data, for standard factory manufactured materials including fiber reinforcement and steel plate dowels.

C. Proposed concrete design mixes. 3 copies of proposed mix and 3 copies of back-up data.

1.03 CODES AND STANDARDS

- A. Comply with the provisions of ACI-301 "Specifications for Structural Concrete".
- B. Perform all work in accordance with rules and regulations of authorities having jurisdiction. In the absence of other authorities comply with State Building Code. In case of conflict most stringent shall govern.

1.04 RESPONSIBILITY OF CONTRACTOR

- A. The Contractor alone shall be fully responsible for the design, strength, safety and adequacy of all formwork, shoring, bracing and all methods of construction.

1.05 INSPECTION, TESTING AND QUALITY CONTROL

- A. A Testing agency will be employed by the Owner to verify the acceptability of materials and the design of the basic concrete mixes.
- B. The Owner shall pay for the cost of the services of the testing agency except that the Contractor shall reimburse the Owner for the cost of those services, which in the opinion of the Architect, are required because of the following:
 - 1. Failure of materials or workmanship to meet Contract requirements.
 - 2. Materials or practices, not complying with the Specifications, which could possibly result in defective work thereby rendering it necessary or advisable to perform tests to determine whether or not work is acceptable.
 - 3. Changes in source, quality or characteristics of materials.
 - 4. Wasted time of inspectors because of cancellations or delays of concrete placement or other work.
 - 5. Site cured cylinders requested by the Contractor to verify strengths for removal of forms.
- C. In general, concrete testing will consist of one set of 3 cylinders for each days casting or every 50 cu. yds.
- D. The Contractor shall cooperate by allowing clear and safe access to the work for sampling, inspection and storage of specimens and equipment. He shall construct a storage box on the site of sufficient size to store 24 cylinders and which will afford the protection required by ASTM C31, Paragraph 7 (A).
- E. Those portions of the structure that do not meet the Contract requirements shall be corrected or removed and replaced as directed by the Architect, and all cost of correction, removal and replacement, shall be at the Contractor's expense.

- F. The Contractor shall notify the Architect and testing agency not less than 24 hrs. in advance of the starting of any project concrete operations.
- G. Manufacturer Representative Presence:
 - 1. Post-installed anchors: The manufacturer's representative for each post-installed anchor product (adhesive, expansion, undercut, screw, or insert anchor) shall be present during the first day's installation of the product to observe whether the anchors are installed according to manufacturer's instructions.
 - 2. Fiber-reinforced concrete: The manufacturer's representative for each fiber type shall be present during the first pour in which the fiber is used to observe whether the dosage rate and placing and finishing method is in accordance with the specifications and the manufacturer's instruction.

1.06 PREINSTALLATION CONFERENCES

- A. Mix Design Conference: At least 30 days prior to submittal of concrete design mixes, the Contractor shall hold a meeting or telephone conference to review the detailed requirements for preparing the concrete mix designs. Participants shall include representatives from the Contractor, Owner's Testing Laboratory, Concrete Supplier, Architect, and Engineer.
- B. Pre-Concrete Conference:
 - 1. At least 7 days prior to beginning concrete work, the Contractor shall conduct a meeting to review the proposed mix designs and to discuss required methods and procedures to produce concrete construction of the required quality. Also review requirements for submittals, status of coordinating work and availability of materials. Establish work progress schedule and procedures for materials inspection, testing and certifications. The contractor shall send a pre-concrete conference agenda to all attendees 7 days prior to the scheduled date of the conference.
 - 2. The Contractor shall require responsible representatives of every party who is concerned with the concrete work to attend the conference, including but not limited to the following:
 - a. Contractor's Superintendent
 - b. Laboratory responsible for field quality control and batch plant quality control
 - c. Concrete Subcontractor
 - d. Ready-Mix Concrete Producer
 - e. Concrete Pumping Contractor
 - f. Fiber Reinforcement and/or Steel Plate Dowel Representative, as required.

- g. Owner's and Architect's/Engineer's Representative.
- 3. Minutes of the meeting shall be recorded, typed and printed by the Contractor and distributed by them to all parties concerned within 5 days of the meeting. One copy of the minutes shall be transmitted to the following for information purposes:
 - a. Owner's Representative
 - b. Project Inspector
 - c. Architect Engineer-of-Record
- 4. The Architect and Engineer shall be present at the conference. The Contractor shall notify the Engineer at least 7 days prior to the scheduled date of the conference.

PART 2 - PRODUCTS

2.01 FORM MATERIALS

- A. Exposed Concrete: Plywood, metal, metal framed-plywood faced or other acceptable panel type material to provide continuous, straight smooth exposed surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Use overlaid plywood complying with US product standard PS-1 "A-C or B-B High Density Overlaid Concrete form", Class I
- B. Concealed Concrete: Plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for a tight fit.

Thickness as required for spans and pressures.
- C. Form Ties:

Shall be of approved design, minimum working strength 3,000 lbs. each, so adjustable as to permit complete tightening of forms. After removal of protruding part of tie no metal to be nearer than 1-1/2" to face of concrete. Ties at exposed surfaces shall have wood, plastic or metal cones. Ties below grade shall have water seal washers.
- D. Form Release Agent Shall Be of commercial formulation with maximum VOC of 450 mg/l that will not bond with, stain or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Rich-Cote as manufactured by Richmond Screw Anchor Co., Inc.
 - 2. Formshield as manufactured by W.R. Grace and Co.
 - 3. Bay Cote as manufactured by Bay Oil Co.

2.02 MATERIALS

- A. Bar Reinforcement - Newly rolled billet steel conforming to the following:
 - 1. ASTM A615 Grade 40 for ties, stirrups and bars to be welded. Welded bars shall also comply with ASTM A706.
 - 2. ASTM A615 Grade 60 for all other bars.
- B. Welded wire fabric reinforcement shall conform to ASTM A185. Sizes as shown on the Drawings. Deliver in sheets, not in rolls.
- C. Reinforcement Accessories:
 - 1. Accessories shall be as manufactured by Superior Concrete Accessories, Inc., Dayton Sure-Grip and Shore Co., R.K.L. Building Specialties Co., Inc. or equal.
 - 2. Accessories shall include all spacers, chairs, ties, slab bolsters, clips, chair bars, and other devices for properly assembling, placing, spacing, supporting, and fastening the reinforcement.
 - 3. Accessories in contact with surfaces exposed to view in the finished work shall conform to CRSI Bar Support Specifications, Class C or Class E.

2.03 MISCELLANEOUS RELATED MATERIALS

- A. Non-shrink grout shall be a mixture of water and a specially formulated packaged mixture approved by the Architect/Engineer, such as Masterflow 713 by Master Builders, EUCO N-S by Euclid Chemical Co., Crystex by L and M Construction Chemicals, or SonogROUT Hyflow by Sonneborn-Contech.
- B. 10 Mil polyethylene shall be installed under all slabs on grade, and shall be used in the widest possible width. Joints shall be lapped a minimum of 6".
- C. Concrete Curing and Sealing Compound:

Liquid membrane forming type conforming to ASTM C309, type I, class A, VOC compliant. Acceptable are:

 - 1. Kure-N-Seal WB30 by Sonneborn Contech.
 - 2. Super Diamond Cure by Euclid Chemical Company.
 - 3. Masterkure by Master Builders Company.

4. Dekote 30 by W.R. Grace Company.
- E. Joint Filler shall be preformed filler provided at slab expansion and control joints, joints between floor slabs and walls, and other isolation joints. Acceptable are:
 1. Precompressed, impregnated open foam cell.
 2. Asphalt saturated fiberboard complying with ASTM D1751.
 3. Granulated cork between saturated felt or glass fiber felt complying with ASTM D1752, Type H.

2.04 CONCRETE MIX MATERIALS

- A. Cement - Portland Cement, ASTM C150 Type I/II or ASTM C595 Type IL.
 1. Maximum cementitious materials substitution, including materials used in the manufacturer of blended cements (ASTM C595), for concrete assigned to Class F3:
 - a. Flyash (ASTM C618) or Ground Granulated Blast-Furnace Slag (ASTM C989, Grade 100 or 120): 25%
 - b. Silica Fume (ASTM C1240): 10%
 - c. Total of Fly Ash and Silica Fume: 35%
- B. Fine aggregate (normal weight) shall consist of washed, inert, natural sand conforming to ASTM C-33.
- C. Coarse aggregate (normal weight) shall consist of well graded, crushed stone or washed gravel conforming to ASTM C-33, 3/4" size.
- D. Water shall be potable.
- E. Water Reducing Admixture, ASTM A494, type A:

"WRDA" - W.R. Grace Co.
"PDA25" - Protex Industries, Inc.
"Pozzolith 200N or 122N" Master Builders Co.
- F. Air Entraining Agent, ASTM C260:

"Darex AEA" - W.R. Grace Co.
"Air Mix" - The Euclid Chemical Co.
"MB-VR" - Master Builders Co.

2.05 CONCRETE MIX DESIGN

- A. It is the intent of this Specification to secure, for every part of the work, concrete of homogeneous structure which, when hardened, will have the required strength, appearance and resistance to weathering.
- B. Basic mix proportions shall be established by the Contractor by means of current laboratory tests made with the constituents to be used in the work. If suitable data are not available, Contractor shall engage a testing laboratory to provide them.
- C. Proportions shall be selected to produce an average strength at least 1200 PSI greater than the normal design strength. (Unless standard deviation data are available to justify a lesser factor).
- D. The following exposure classes and associated requirements shall apply:
1. Concrete subject to cycles of freezing and thawing with frequent exposure to water and deicing chemicals (including pavements and foundation walls exposed above grade): Class F3
 - a. $w/cm = 0.40$ max
 - b. $f'c = 5000$ psi min
 - c. Air Content: entrained 6 percent +1, - 2 percent
 2. All other concrete (including interior slab on grade): Class F0
 - a. $w/cm = 0.50$ max
 - b. $f'c = 3500$ psi min
 - c. Air Content: entrapped 3-1/2 percent +1, -2 percent
- E. The consistency of the concrete at time of deposit as measured by ASTM C143, "Standard Method of Test for Slump" shall be as follows:
1.

Portion of the Structure	Slump
Reinforced walls, beams and columns	4" +/- 1"
All other concrete	3" +/- 1"
 2. For all areas: Mid Range Water Reducer added at plant 5" +/- 1"
 3. For all areas: High Range Water Reducer mix slump 8" max
- F. Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.

- 3. Use high range water-reducing admixture in pumped concrete, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.40.
- G. No concrete may be placed in the work until the appropriate design mix has been reviewed and accepted by the Architect/Engineer.
- H. If, during the progress of the work, any difficulty should occur in securing concrete of the required workability and strength, the Architect may order such changes in the proportions or materials, or both, as may be necessary. Any changes so ordered shall be made at the Contractor's expense.

2.06 MIXING AND DELIVERY OF CONCRETE

- A. All concrete shall be ready-mixed produced by a plant acceptable to the Architect. All constituents, including admixtures, shall be batched at the central batch plant.
- B. Cold weather requirements: When the air temperature is at or below 45 degrees F, or when weather reports indicate that the air temperature may fall below 45 degrees F within 24 hrs immediately following the completion of concrete placement, the mixing water and, if necessary, the aggregates shall be heated so that the concrete shall have a temperature of 55 degrees to 80 degrees when placed. If the mixing water is heated, it shall not have a temperature in excess of 140 degrees F at the time it is added to the cement and aggregates.
- C. Hot weather requirements: During hot weather the concrete shall, at the time it is placed, have a temperature from 55 to 80 degrees F but never above 90 degrees F. Provide crushed ice in lieu of equal weight of mixing water if necessary. Ice must be completely dissolved before placing.

PART 3 - EXECUTION

3.01 INSTALLATION OF FORMS AND SHORING

- A. Forms shall be so designed by the Contractor to withstand all dead and live loads, including construction live loads, and to not move out of specified tolerances for line and elevation. Forms and form accessories shall be so designed that upon removal they will in no way damage concrete surfaces.
- B. Forms shall be built mortar-tight.
- C. Holes for concrete placement through sides of forms shall not be used.
- D. Forms for beams and other horizontal surfaces shall be constructed with adequate camber resulting in level surfaces before forms are removed.

- E. Before form materials are re-used, surfaces that will be in contact with freshly cast concrete shall be thoroughly cleaned, damaged areas repaired, and all projecting nails withdrawn.
- F. Before reinforcement is placed on or against formwork, surfaces of forms coming in contact with fresh concrete shall be cleaned and then treated with approved form release agent.
- G. Set and maintain concrete formwork to insure completed work is within the tolerance limits listed in ACI 347.

3.02 CONSTRUCTION JOINTS

- A. Joints not indicated on Plans shall be located and constructed so as to least impair strength and appearance of work.

3.03 COORDINATE INSTALLATION OF EMBEDDED ITEMS WITH OTHER TRADES

- A. Install all embedded items to conform to the requirements of ACI 318 and as specified below. Do not install any accessories until the affected trade has verified their type and location.
- B. Coordinate the installation of all inserts required by other trades prior to placing of reinforcing steel.
- C. Install anchor bolts, etc., furnished by other Sections. Use line and transit to locate anchor bolts and secure with templates to prevent displacement during concreting operations. Survey of completed anchor bolt placement and submit discrepancy reports to Architect/Engineer immediately for resolution prior to proceeding with erection of other trades.
- D. Provide steel sleeves for pipes passing through concrete.

3.04 INSTALLATION OF REINFORCEMENT

- A. Reinforcing shall be accurately placed and rigidly secured in position.
- B. Tie reinforcing with annealed #18 gauge (min.) wire, and bend all wire back beyond general plane of reinforcing.
- C. Welded wire fabric reinforcement in slabs shall be continuous, shall have joints lapped at least one full mesh, but not less than 6" and shall be supported at proper elevations by accessories.
- D. Bending, Tack welding, Cutting or substituting reinforcement in the field, other than shown on the Contract Drawings, in any manner is prohibited, unless specific approval for each case is given by the Architect or his designate.

- E. At the time the concrete is placed, all reinforcement shall be free from excessive rust, scale, or other coatings, which might destroy or reduce the bond.
- F. Before concrete is cast, check all reinforcement after it is placed to insure that reinforcement conforms to Contract Drawings and approved shop detail drawings and Specification requirements. Such checking shall be done only by qualified, experienced personnel. In addition, the Architect's representative shall be notified at least 36 hrs prior to concrete placement and given the opportunity to inspect the completed reinforcement and formwork before concrete placement.

3.05 PLACING CONCRETE

- A. Transport concrete mixes to place of final deposit as rapidly as practical by methods, which prevent segregation.
- B. Remove water and all foreign matter from place of deposit. Place no concrete on frozen soil.
- C. Calcium chloride shall not be used anywhere on the site for any purpose.
- D. At construction joints, the surfaces of the concrete already placed shall be thoroughly cleaned of foreign materials and laitance, dampened with water and "Euco Weld" by the Euclid Chemical Company or approved equal, shall be applied. New concrete shall be placed after the bonding compound has dried.
- E. Concrete shall be placed in such a manner as will prevent segregation.
- F. Vertical lifts shall not exceed 18".
- G. Concrete, during and immediately after depositing, shall be thoroughly compacted by means of suitable internal type vibrators.
- H. Chutes, hoppers, spouts, adjacent work, etc., shall be thoroughly cleaned before and after each placement.
- I. All slabs on grade shall be finished to exact elevations shown on the drawings. The slab thickness shall be increased where necessary to compensate for all settlements and deflection due to the weight of the wet concrete.

3.09 REPAIR AND FINISH OF CONCRETE SURFACES

- A. Concrete surfaces shall be repaired by using either the same material as originally cast or by use of a dry-pack material. Areas affected shall be chipped back square and to a depth of 1" min. Holes shall then be moistened with water for minimum of 2 hrs. Then followed by a brush coat of Euroweld as manufactured by Euclid Chemical Co. As soon as Euroweld becomes tacky, immediately plug the hole with a dry pack material

consisting of 1:1-1/2 mixture of cement and concrete sand mixed slightly damp to the touch. Hammer the dry-pack into the hole until dense and excess of paste appears on the surface. Finish the patch to the same texture as surrounding concrete. Color of patch after curing shall match adjacent concrete exactly. Adjust color if necessary using white cement or limestone aggregate.

3.10 FINISHING OF FORMED CONCRETE SURFACES

- A. Formed concrete surfaces to be painted or exposed to view in the finished work shall be finished as follows:
 - 1. As soon as the forms have been stripped, fins and other projections shall be removed, surface defects shall be patched, and repairs to defective concrete and honeycombed areas shall be made, clean all exposed concrete surfaces and adjoining work stained by the leakage of concrete, to the approval of the Architect/Engineer.
 - 2. Immediately after removal of forms, remove form tie plugs. Holes shall then be promptly filled upon stripping as follows: Moisten the hole with water, followed by a 1/16" brush coat of neat cement slurry mixed to the consistency of a heavy paste. Immediately plug the hole with a 1:1.5 mixture of cement and concrete sand mixed slightly damp to the touch (just short of balling). Hammer the grout into the hole until dense, and an excess of paste appears on the surface in the form of a spiderweb. Fill hole flush with concrete surface and finish smooth.

3.11 FINISHING FLATWORK

- A. Provide slab surface of following specified flatness and levelness when tested in accordance with ASTM E1155. Remove surface irregularities to provide a continuous smooth finish.
- B. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed to view and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.
 - 1. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with the surface leveled to the following tolerances. Grind smooth surface defects that would telegraph through applied floor covering system.

Portion of the Structure	FF		FL		WI2-10(in)
	Specified	Minimum	Specified	Minimum	
Warehouses	60	25	30	15	0.100
All other (office, etc)	30	18	15	10	0.140

- C. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.
- D. Nonslip Broom Finish: Apply nonslip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordination required final finish with Architect before application.

3.12 CURING, PROTECTION AND FORM REMOVAL

- A. Formed surfaces shall be periodically sprayed with water while forms are in place and, after forms are stripped, kept continuously wet and at a minimum temperature of 50 degrees F for 7 days.
- B. Unformed surfaces such as slabs shall be moist cured at a minimum temperature of 50 degrees F for 7 days or given 2 successive uniform coatings of approved curing and sealing compound. Each coat shall consist of not less than 1 gal to 400 sq. ft.
- C. Cold weather protection - When the air temperature is at or below 45 degrees F or when weather reports indicate that the temperature may fall below 45 degrees F within the 24 hr. period following placement of concrete, take all adequate and proper measures as required to maintain the temperature of the concrete between 50 degrees F and 70 degrees F for the specified curing period and to protect the concrete against damage by freezing or the cold, including but not limited to the following:
 - 1. Ascertain that the requirements for heating of aggregates and water have been followed.
 - 2. Heat formwork, reinforcing and underlying subgrades with live saturated steam so as to raise the temperature well above the freezing point. Concrete surfaces shall be covered to prevent direct contact with the steam.
 - 3. After placing of concrete, protect against cold by means of tight covering and supply of sufficient heat, where required, to maintain the temperature of the concrete at a temperature of 50 to 70 degrees F for at least 7 days after placement of concrete. The concrete shall not be protected with salt, hay, manure or any other material containing live or organic acids. Concrete shall be kept continually moist during the curing periods.
 - 4. The section to be concreted shall be completely housed or enclosed wherever practicable before placing of concrete, in a manner that will insure the maintenance of the required temperatures. Such enclosures shall be left in place during the curing period.

- D. Hot weather protection - Take special care during the concreting operations during hot or dry weather. Wet forms just before placing of concrete and keep exposed surface continuously damp. Take special precautions in placing of slabs in unshaded locations so as to prevent flash setting of concrete. Provide a continuous fog spray of water immediately after screeding and maintain in moist condition and take such other protective measures as required to prevent damage from flash setting of concrete. Do not use retardant admixtures, other than specified by the Architect. Except as modified above, follow procedures as outlined in ACI 305.
- E. Removal of Forms:
 - 1. Remove forms only after concrete has attained sufficient strength to support its own weight and all loads thereon.

3.13 GROUTING OF ANCHOR BOLTS AND BASE PLATES

- A. Grout Mixture: Use an approved packaged grout mix with the minimum amount of water required to produce a flowable grout. Extend grout with 3/8" coarse aggregate for grout placement over 2 inches thick.
- B. Mixing: Per approved grout manufacturer's printed instructions. Do not mix more grout than can be placed within twenty (20) minutes.
- C. Preparation:
 - 1. Remove all defective concrete, laitance, dirt, etc. from the concrete surface. Saturate the surface of the concrete thoroughly with clean water for at least 24 hours. Remove free water just prior to placing the grout.
 - 2. Clean, align, and level the base plate into final position and maintain that position during grouting. Bring the concrete and plate to be grouted to a temperature between 65 degrees to 90 degrees F. just prior to grouting.
- D. Grouting:
 - 1. Place the grout quickly and continuously to provide complete bearing and avoid air entrapment.
 - 2. After the grout has acquired its initial set, cut off all unconfined, exposed edges, leaving slopes "shoulders". Paint the entire area within 24 hours with an approved curing compound.

END OF SECTION 033000

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

1. Furnish all labor, material, and equipment necessary to complete all structural steel work as shown and/or specified.

B. Related Work Specified Elsewhere:

1. Testing Laboratory Services: Section 014110.
2. Grouting of Bearing and Base Plates: Section 033000.
3. Miscellaneous Metal: Division 5.
4. Field Paint for Exposed Steel.

C. Furnished but Installed Under Other Sections:

1. Anchor Bolts: Section 033000.
2. Loose Lintels: Division 4.

D. Specified Elsewhere But Included Under This Section:

1. Contractor's Responsibilities Associated with Testing Laboratory Services: Division 1.

1.02 QUALITY ASSURANCE

A. Erector's Qualifications:

1. Satisfactorily completed projects of similar magnitude.

B. Fabricator's Qualifications:

1. Satisfactorily completed projects of similar magnitude.
2. Facilities and capacity to provide fabricated steel to facilitate timely completion of project.

C. Welder's Qualifications:

1. All shop and field welding is to be performed by operators who have passed the test as prescribed in AWS D1. 1 Chapter 5 "Qualifications", and qualified to perform the type of welding required.

2. Each welder working on the project shall be assigned an identification symbol or mark and shall mark or stamp his identification at each completed weldment, both in the shop and field.
3. The fabricator and erector shall submit to the Architect welder's qualifications prior to fabrication and erection.

D. Inspection and Quality Control:

1. The Fabricator shall provide effective full time quality control over all fabrication activities. This shall include ultra-sonic, magnetic particle, dye penetrant, x-ray, or other effective means of insuring that all welds fully conform to A.W.S. Standards. The Owner's testing agency may visit the plant as directed by the Architect to verify that a quality control program is being maintained and to spot check weldments and welding procedures. All fabricated items may also be subject to inspection in the field including ultra-sonic testing. Inspection by the testing agency is not intended to be comprehensive or complete and full responsibility for quality control shall remain with the Fabricator.
2. The Owner or his representative shall have the right to reject any item not fully conforming to all requirements of the Contract Documents.

1.03 REFERENCE CODES AND STANDARDS

A. Comply with the provisions of the following, except as otherwise indicated.

1. AISC "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings".
2. AISC "Code of Standard Practice for Steel Buildings and Bridges".
3. AISC "Manual of Steel Construction".
4. AISC "Specifications for Structural Joints using ASTM A325 or A490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Council.
5. AWS D1.7 "Code for Welding in Building Construction".
6. SSPC "Structural Steel Painting Manual".
7. Painting Manual, Vol. 1, "Good Painting Practice" and Painting Manual, Vol. 2, "Systems and Specifications", Steel Structures Painting Council.
8. All pertinent Federal, State, and Local Codes.

B. In case of conflict between specified codes and standards, the most stringent requirements govern. In case of conflict between codes and standards and Project Specifications, Project Specifications shall govern.

1.04 SUBMITTALS

A. Shop Drawings:

1. Include all information necessary for steel fabrication and erection, including:
 - a. Standard details of proposed beam end connections with load capacities, and other job standards for appropriate parts of the work. Submit for approval before preparation of detail drawings. Consistently use standard details on Detail Drawings where appropriate.
 - b. Anchor bolt, leveling plate and bearing plate: Plans showing the location, size, and identification marks of all base plates, screws, bolts, grade of steel, and setting elevations.
 - c. Erection plans, showing type, size, weight, location identification marks of all members and all information regarding field welds and bolts.
 - d. Detail Drawings, showing complete details of all members including identification marks, dimensions, sizes, grade of steel, holes, shop and field welds, connection details, shop and field bolts, cleaning requirements prior to painting, type of paint and other pertinent data.
 - e. Include on drawings all temporary members required for erection.
 - f. Submit shop drawings for review.
2. Product Data:

For all standard manufactured products, including paint.
3. Certificates:
 - a. Prior to delivery of steel to the project site, submit certified copies of mill test reports including name and location of mill and analysis of chemical and physical properties of steel to be used on this project.
 - b. Provide certification that welders to be employed in the work have satisfactorily passed AWS qualification tests within the previous 12 months.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Rolled Steel Wide-Flange Shapes & WT shapes cut from wide flange: ASTM A-992.
- B. Rolled Steel Plates, Bars, and Non Wide-Flange Shapes: ASTM A-36 unless otherwise indicated.
- C. Cold-Formed Steel Tubing: ASTM A-500, Grade B.

- D. Structural Pipe: ASTM A-501 or A-53 Grade B.
- E. High Strength Bolts: ASTM A-325. A-490.
- F. Standard Anchor Rods: ASTM F1554, Grade 36.
- G. Electrodes for Welding: AWS E70 Series.
- H. Paint for Shop Primer:
 - 1. Non-exposed Steel
 - a. Paint for shop primer shall have not less than 50 percent solids, per volume, and shall withstand the following tests without any change in adhesion, film integrity, hardness, color, blistering or cracking:
 - 1. Freeze Thaw: ASTM D2246, 30 cycles
 - 2. Salt Spray Resistance: ASTM B117, 500 hours
 - 3. Light and Water Resistance: ASTM D822, 5000 hours
 - b. Acceptable Products:
 - 1. #99 or #88 Primer by Tnemec Co., Inc.
 - 2. Ceco #265 by Cheesman-Elliot Co.
 - c. Paint shall provide a minimum bond capacity for the adhesion of spray fire-proofing of 100 psf or greater. Submit certificates of compliance.
 - d. Other products will be considered if request is accompanied by certified test reports showing compliance with all the above requirements.
 - 2. Exposed Steel:
 - a. Acceptable Product: Series 90-93 Zinc Primer by Tnemec Company.

2.02 DESIGN

- A. Connections:
 - 1. Design and detail all connections to resist the loads and reactions indicated on the Drawings or specified herein. Details shall supplement and be consistent with details shown on the Drawings. Proper account of eccentricity shall be taken in the design of connections so that there is no overstressing of any material either in the connections themselves or in the connected members. The design of all connections shall be subject to the approval of the Architect/Engineer.

- a. Shop and field connections shall be made using minimum 3/4" diameter high strength bolts or by welding, unless otherwise indicated.
- b. Beam-to-column connections shall be such as to minimize eccentric loading on the column. Unrestrained simple beam end connections shall be detailed and fabricated so as to minimize end restraint of the beam. All parts of such connections (such as welds, bolts and material) shall be designed taking eccentricity into account.

2. Temporary Bracing:

The Contractor shall be fully responsible for the design, strength, safety and adequacy of all temporary bracing and all methods of construction. The specifying herein of requirements for bracing or construction methods, preliminary approvals by the Architect, or any other requirements of the Specifications shall be construed as the minimum acceptable, and shall not eliminate, lessen or restrict in any manner the responsibility of the Contractor for all construction methods and for the safety and stability of the structural steel work at all stages of erection, until such time as the permanent bracing system becomes effective.

2.03 FABRICATION

A. Installation of High Strength Bolts:

1. Shop installed high strength bolts shall be installed as specified below under "Execution".

B. Welding:

1. Shop welding shall be done by either shielded metal arc welding, submerged arc welding or flux core arc welding. (SMAW, SAW, FCAW). Gas metal arc welding (GMAW) is not permitted.
2. Prepare joint welding procedures and program of welding sequence (for each component and for welding joining components to each other) and submit to Architect for approval before any welding is done. After approval, welding procedures and sequences shall be followed without deviation unless specific approval for change is obtained from Architect. Architect may require requalifications of operators for such changes in welding procedures by test prescribed in AWS "Standard Qualification Procedures".

C. Cutting:

1. Manual oxygen cutting shall be done only with a mechanically guided torch, except as permitted below:
 - a. Gas cut edges, which are not to be welded, and which will be free of substantial stresses (as determined by the Architect/Engineer) may be cut manually with an unguided torch provided that specified AISC edge distances to holes are maintained.

- b. Gas cut edges which will be subjected to substantial stress (over 1/2 the allowable stress, as determined by the Architect/Engineer), or which are to be welded may be cut manually with an unguided torch to a line not within 1/8" of the finished dimension, with final removal of material completed by chipping or grinding to produce a surface quality equal to that of the base metal edges.
 - 2. Punch and drill steel for attachment of other materials indicated on the Drawings or noted in the Specifications to be attached to the steel.
 - 3. Holes for bolted connections shall not be oxygen cut. Components prepared in this manner will be rejected.
 - 4. All re-entrant corners shall be shaped notch-free to a radius of at least 1/2".
 - 5. Cut no openings without the written approval of the Architect/ Engineer.
- D. Milled Ends:
- 1. Where loads are transferred by bearing at ends of columns, ends shall be milled.
- E. Identification:
- 1. Each structural steel member shall have its assigned position and identification mark or symbol plainly indicated thereon near one end. Marks shall agree with those shown on the Shop Drawings and Erection Drawings.

2.04 SUPPLEMENTAL FRAMING:

- A. Provide supplemental framing at all openings as shown on the Drawings and at all suspended loads.
- B. Where open web joists are used, provide additional framing to transfer loads from the supplemental framing and suspended loads to panel points. Coordinate with the steel joist Contractor and provide him with sufficient information to enable him to incorporate shop welded connections to panel points on his Shop Drawings. Where such information is not so provided, structural steel Contractor shall supply and install the necessary connections.

2.05 SHOP PAINTING:

- A. Cleaning and Preparation:
 - 1. Painted Steel
 - a. Non-exposed steel specified to be painted shall be cleaned in accordance with SSPC-SP3.
 - 1. Non-exposed steel is defined as steel not exposed to the elements. Usually contained within building envelope.

- b. Exposed steel to be painted shall be cleaned and lightly sandblasted in accordance with SSPC-6. Connections are to be included.
 - 1. Exposed steel is steel, which is exposed to the elements.
 - 2. Unpainted Steel
 - a. Unpainted steel to receive fire-proofing shall be free of all oil, grease, loose mill scale, salt, dirt and any other substance that impairs proper adhesion of the fire-proofing.
 - b. All other unpainted steel shall be cleaned of oil and grease by solvent cleaners and cleaned of dirt and other foreign materials by thoroughly sweeping with fiber brushes.
- B. Surfaces to be Painted:
 - 1. Typically, non-exposed steel to be fire-proofed is not painted; exceptions are:
 - a. Atriums.
 - b. Kicker angles, masonry supports.
 - c. Steel not receiving fire-proofing.
 - d. Special pieces as indicated on the Structural Drawings.
 - 2. Exposed steel and related connections are painted. Extent is indicated on the structural Drawings.
- C. Surfaces to Receive Protective Coating:

Machine finished surfaces such as bearing surfaces of column and base plates.
- D. Method and Rate of Paint Application:
 - 1. Non-exposed Steel
 - a. Apply one prime coat of paint to dry, clean surfaces by brush, spray or roller with no running or sagging.
 - b. The coverage rate per coat shall not be more than 400 sq. ft. per gal. resulting in a minimum wet film thickness of 4 mils and providing a minimum dry film thickness of 2 mils.
 - c. If for any reason any surface to be field welded or bolted is painted, remove such paint completely to within stated limits before field welding or bolting. If any machine finished surface is painted, remove such paint completely, and touch up specified finish if required, before shipping or erection.

2. Exposed Steel

- a. Single coat of Zinc Primer, minimum dry film thickness 4.0 mils, to be applied in strict conformance with manufacturer's printed requirements.

PART 3 - EXECUTION

3.01 ERECTION:

- A. Verify that anchor bolts and bearing plates are of the size required and accurately located, prior to erection of the steel.
- B. Set base plates and bearing plates level to correct elevations and support temporarily on steel wedges, shims, leveling devices, or as shown on Drawings, until corresponding supported member has been positioned, plumbed and anchor bolted. Leave protruding leveling devices in place until after grout has been placed and has attained required strength, and then cut off flush with top or edges of base plate, or both, except as otherwise noted.
- C. Align, level, and adjust all members accurately prior to final fastening. Bearing surfaces and surfaces that will be in permanent contact shall be cleaned prior to final assembly of members. Drift pins shall be used only to bring together the several parts. They shall not be used in such manner as to distort or damage the metal.
- D. As erection progresses, the work shall be securely connected to safely resist all dead load, wind and erection forces. Temporary bracing shall be introduced wherever necessary to safely resist all loads to which the structure may be subjected, including erection equipment and its operation. Such bracing shall be left in place as long as may be required for safety.
- E. Oxygen cutting in the field shall not be done except with written permission to the Architect. When permitted, it shall be executed in accordance with the requirements herein specified.
- F. All temporary supports, flooring, planking, and scaffolding necessary in connection with the erection of the structural steel, or the support of erection equipment, shall be provided as a part of the erection work. The temporary floors shall be as required by Federal, State and Municipal Laws and governing safety regulations.
- G. Protect expansion joints during all construction phases such to prevent any accumulation of debris or other deleterious materials in the sliding plane.

3.02 FIELD WELDING:

- A. Field welding shall be done with shielded metal arc welding (SMAW) or flux core arc welding (FCAW) only.
- B. The Contractor shall provide safe and substantial work platforms at proper height to permit best possible field welding technique. Temporary enclosure, shielding, etc., shall

be provided to protect welding operators and joints to be welded against the elements during welding operations.

3.03 INSTALLATION OF HIGH STRENGTH BOLTS:

- A. Provide safe and substantial work platform for bolting crews.
- B. Each bolting crew working on the project shall be assigned an identification symbol or mark. Each bolting crew shall mark this identification on each joint completed.
- C. Joints shall be made without the use of erection bolts, the high strength bolts required for the joint serving that purpose themselves. Where proper fix-up cannot be obtained, corrective work or additional plumbing, leveling, etc. may be required. Use not more than 2 washers per bolt.
- D. Correct poor matching of holes by drilling to next larger size and use of larger size bolt, if approved by Architect/Engineer. Welding for redrilling shall not be done.
- E. High strength bolts shall be installed by the "modified turn-of-the-nut method", or by the use of load indicator washers, or by the use of torque control bolts. (See below)

3.04 INSTALLATION OF HIGH STRENGTH BOLTS BY "MODIFIED TURN-OF- THE-NUT METHOD":

- A. Install high strength steel bolts in accordance with the turn-of-the-nut method in the AISC approved "Specification for Structural Joints using ASTM A325 or A490 Bolts", with the following additional requirements:
 - 1. Use hardened washer under bolt head or nut, whichever is turned in tightening (unless oversize holes have been approved, in which case washers are required under head and nut).
 - 2. At the start of each day, each operator shall field test his power impact wrench as directed by the testing agency or Architect and as described below using bolts representative of those to be used in the work.
 - 3. Field testing of each impact wrench shall consist of tightening, in a hydraulic tension-measuring device such as a Skidmore Wilhelm Calibrator furnished by the Contractor, three bolts of each size to be used, with a hardened washer under either bolt head or nut, whichever is turned in tightening. Bolt tension readings shall be taken at "snug-tight plus fraction of turn" (tabulated in Table 4) conditions to confirm that bolts and equipment have the capacity to develop the minimum tension tabulated in Table 3.
 - 4. While power impact wrenches are being field tested, the testing agency shall be given the opportunity to determine the torque-tension relationship for its manual torque indicator wrench for every combination of impact wrench and bolt size to be used in the work for the day. These torque values shall be used as the inspection standard in testing the actual installations.

5. Install bolts using powered impact wrenches with sufficient capacity and an adequate supply of compressed air.

3.05 INSTALLATION OF HIGH STRENGTH BOLTS BY THE USE OF LOAD INDICATOR WASHERS:

A. Load indicator washers used as direct tension indicators shall be installed as follows:

1. The load indicator washer shall be placed on the bolt with the protrusions facing the bolt head.
2. The assembly shall be fitted into place and the nut installed. Hardened round washers shall be used under the nut to reduce frictional resistance.
3. Sufficient bolts in the joint shall be "snugged" to draw the connecting members into close contact, then all bolts shall be tightened until the average gap between the face of the load indicator washer and the underside of the bolt head is reduced to at least .015", but not closed completely.
4. Tightening shall progress systematically from the most rigid part of the joint to its free edges until the load indicator washers on all bolts are closed to at least the required gap. Gaps shall be checked with a feeler gauge. Complete closure of the gap should be avoided, but it is not necessarily reason for rejection provided bolts have not been tightened more than one complete turn beyond snug position.
5. When it is required to use the load indicator under the nut, a hardened round washer shall be fitted between the load indicator washer and the nut. After the bolt is installed in the connection, the load indicator washer shall be placed on the bolt with the protrusions facing the nut. The hardened round washer shall be placed against the load indicator washer protrusions before the nut is installed. For this assembly, tightening is continued until the average gap between the load indicator washer and the hardened round washer is closed to at least .0152" if the bolt head is turned during installation, and to at least .010" if the nut is turned in accordance with the procedure given above.
6. If the load indicator washer must be placed under the head, and the head must be turned, then a hardened round washer must be used between the load indicator washer protrusions and the bolt head. For this fastener assembly, the average gap between the load indicator washer and the hardened round washer shall be closed to .010".
7. Install bolts using pneumatic powered impact wrenches with sufficient capacity and an adequate supply of compressed air.

3.06 INSTALLATION OF HIGH STRENGTH BOLTS BY TORQUE CONTROL BOLTS:

- A. A hardened washer shall be installed under the nut (unless oversized holes have been approved, in which case washers are required under head and nut).
- B. Torque control bolts shall be installed by a special torquing device recommended by the manufacturer. The torquing device shall engage the spline end of the fastener and

prevent the bolt from rotating while the nut is being tightened. The bolts shall then be tightened until the counter-torque is sufficient to shear the spline end from the bolt.

- C. At least 3 torque control bolts from each shipment shall be tested in a hydraulic tension-measuring device such as a Skidmore-Wilhelm Calibrator furnished by the Contractor. Bolts are to be fully tightened using the same equipment proposed for use in the structure. Tests shall be performed in the presence of the testing agency. If any bolt fails to reach the minimum tension required by ASTM A325, that bolt shall then be tightened using a calibrated torque wrench until the required tension reading is observed on the calibrator. Bolts from that shipment shall then be tested in the field using the same calibrated torque wrench and the cost of such testing shall be at the Contractor's expense.

3.07 CORRECTIVE WORK:

- A. Structural steel members or assemblages having fabrication errors, or which have deformations preventing proper assembly and fitting of parts, shall be reported immediately to the Architect. They shall not be incorporated in the finished work. Such members or assemblages may be corrected if permitted by the Architect, such corrective work shall be in accordance with the Contract Documents.
- B. Submit to the Architect for approval Drawings showing reasons for and details of proposed corrective work, and receive approved Drawings prior to performing the corrective work.

3.08 FIELD TOUCH-UP PAINTING:

- A. After erection all exposed metal surfaces where shop coat is missing or has been damaged shall be touched-up using the same type of paint as approved for the shop coat.
- B. Prior to touch-up, all areas to be painted shall be thoroughly cleaned of rust, dirt and weld slag.
- C. Touch-up paint shall extend a minimum of 2" onto undamaged finish.
- D. Paint shall be uniformly applied to dry surfaces to a dry film thickness of no less than 2 mils, 4 mils for exposed steel.

END OF SECTION 051200

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. Testing Laboratory Services: Section 014110.

1.02 QUALITY ASSURANCE

- A. Welder's Qualifications:

1. Qualifications of welders shall be as prescribed in the "Standard Qualification Procedures" by the American Welding Society.
2. Welding operators shall have been previously qualified to perform the type of work required for this project.

- B. Reference Standards:

Unless otherwise indicated herein, perform work in accordance with the following standards:

1. Steel Deck Institute: "Code of Recommended Standard Practice".
2. American Welding Society: "Code for Welding in Building Construction".
3. American Iron and Steel Institute: "Specifications for the Design of Light Gauge Cold-Formed Steel Structural Members".
4. Factory Mutual: Loss Prevention Data 1-28 Insulated Steel Deck.

1.03 SUBMITTALS

- A. Shop Drawings:

1. Indicate all details of fabrication and installation.
2. Deck: Include type, gauge, finish, location, openings, dimensions, anchorage details, lap details, accessories and shoring requirements (if any).
3. Shear Connectors: Include type, number, location, typical details and welding data.

- B. Product Data:

1. For each type of Deck.

C. Certification:

1. Evidence of welders qualifications.
2. Certifications from an approved independent Testing Laboratory indicating compliance with specified fire resistance requirements.

1.04 STORAGE AND HANDLING

- A. Do not store deck in direct contact with ground.
- B. Do not damage deck during handling.
- C. If mud, dirt or other foreign matter does accumulate on the deck, completely remove such accumulation prior to erection.

PART 2 - PRODUCTS

2.01 DESIGN

- A. Span each deck unit over 3 or more spans, minimum load capacity equivalent to SDI Standard Load Tables.
- B. Where deck spans less than 3 spans, increase the gauge of the deck to provide the same load capacity as shown in SDI Standard Load Tables for 3 or more spans.

2.02 A. Acceptable Products:

1. Type 1.5B by Vulcraft Div. Nucor Corp.
2. Type B by New Millenium Building Systems
3. Type B by Canam Steel Corporation

B. Material:

1. Steel Sheet, ASTM A611 with a minimum yield strength of 33,000 PSI.
2. Physical Properties:
 - a. Depth 1-1/2"
 - b. Per plan

C. Fire Resistance Requirements:

Comply with "FM Loss Prevention Data 1-28" for attaching deck.

D. Finish:

Protect with a zinc coating conforming to ASTM A-525 coating designation G60.

2.03 ACCESSORIES

- A. Roof Sump Plates: 24" square, minimum 20 gauge flat sump pan, required at each roof drain where metal deck is to receive rigid insulation.
- B. Closures:
 - 1. Metal Closures: Minimum 20 gauge steel with same finish as adjacent deck.
 - 2. Flexible Closure Strips: Rubatex by Rubtex Corporation, or approved equal and shall conform to profile of various decks as required.

2.04 FIELD TOUCH-UP (Galvanized Surfaces)

- A. Acceptable Products:
 - 1. Z.R.C. Cold Galvanizing Compound by Z.R.C. Chemical Products Company.
 - 2. Zinc clad 5 primer by Sherwin Williams Company.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Prior to proceeding with installation of deck, the following shall have been completed:
 - 1. Related steel framework plumbed, aligned and completed.
 - 2. Temporary shoring installed (if required).
 - 3. Ice, oil, dirt, rust, and other materials which may adversely affect welding shall have been removed.

3.02 INSTALLATION

- A. Placing Deck Units:
 - 1. Position metal deck units on supporting steel and accurately align to final position with units resting tightly on top of all supporting members. Do not stretch or contract the side lap interlocks.
 - 2. Minimum bearing on steel supporting members shall be 2".
 - 3. Minimum end laps shall be 2".
 - 4. Center ends of deck over center of supports.

B. Cutting and Fitting:

1. Shop Cutting: Cut to proper length before shipping to the field.
2. Field Cutting By Metal Deck Erector:
 - a. Notch to fit around columns and other similar fabrication.
 - b. All holes and openings which are located and dimensioned on the structural drawings.
 - c. Holes in deck larger than 6" and up to 12" in diameter:
 1. Deck erector shall furnish and install 1-1/2" x 1-1/2" x 3/16" galvanized steel angle 5'-0" long on one or both sides of each hole, perpendicular to flutes, as required. (Both sides if any portion of hole occurs in middle 1/3 of deck span, otherwise one side.)
 2. Attach angle to underside of deck by bolting or puddle welding at each bottom flute.
 3. Do not space holes closer than 5'-0" on center in any span.
3. Field Cutting By Other Trades:
 - a. Holes and openings required for work under other Sections of the Specifications, which are not located and dimensions on the structural drawings and are 6" in diameter or less shall be cut by the respective trade. Not more than one rib shall be cut per panel per span.
 - b. Method and Quality of Cutting: All cuts shall be neat and trim in appearance, cut deck with metal saw, drills or cutting torch.

C. Closures:

1. Provide metal closures for all openings in composite metal deck 1/16" wide and over, including the following:
 - a. Cover plate to close panel edge and end conditions and where panels change direction or abut.
 - b. Column closures to close openings between metal deck and structural steel columns.
 - c. Where deck is cut for passage of pipes, ducts, columns, etc. and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck.

2. Restrictions:

Do not cut openings greater than 6" diameter in deck unless they are shown on the reviewed shop drawings or unless approved in writing.

D. Fastening Deck Units:

1. Arc weld deck to supporting steel as follows:

- a. Use welding washers for decks less than 22 gauge.
- b. Refer to drawings for requirements indicated.

2. Alternate fastening or for supporting steel less than 1/4" in thickness:

- a. Self-drilling fasteners (#10 minimum) or Powder Actuated Fasteners with size and spacing as required to provide a diaphragm shear capacity equal to or greater than provided by welding requirements above.
- b. Submit diaphragm shear capacity data for approval prior to installation.

3.03 FIELD TOUCH-UP PAINTING

A. Preparation:

- 1. Thoroughly clean areas to receive touch-up paint of all rust, dirt, oil and weld slag.
- 2. Accomplish touch-up soon after deck is erected.
- 3. Touch-up shall include but not limited to abrasions, scars, cut edges and welds.
- 4. Extend paint minimum of 2" onto undamaged finish.
- 5. Minimum dry film thickness: 2 mils.

B. Galvanized Surfaces:

Apply material specified for galvanized surfaces.

C. Painted Surfaces:

Apply same material used for prime coat.

END OF SECTION 053100

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Warning tape.
4. Pipe labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve-numbering scheme.
- E. Valve Schedules: For each piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Brady Corporation.
2. Material and Thickness: Brass, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
3. Letter and Background Color: As indicated for specific application under Part 3.

4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Brady Corporation.
2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
3. Letter and Background Color: As indicated for specific application under Part 3.
4. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Brady Corporation.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 WARNING TAPE

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Brady Corporation.
- B. Material: Vinyl.
- C. Minimum Thickness: 0.005 inch.
- D. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.
- E. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.
- F. Maximum Temperature: 160 deg F.
- G. Minimum Width: 4 inches.

2.4 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Brady Corporation.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:

1. Pipe size.
2. Flow-Direction Arrows: Include flow-direction arrows on main distribution piping. Arrows may be either integral with label or applied separately.
3. Lettering Size: Size letters in accordance with ASME A13.1 for piping.

2.5 STENCILS

A. Stencils for Piping:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Craftmark Pipe Markers.
2. Lettering Size: Size letters in accordance with ASME A13.1 for piping.
3. Stencil Material: Aluminum, brass, or fiberboard.
4. Stencil Paint: Exterior, gloss, alkyd enamel in colors complying with recommendations in ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
5. Identification Paint: Exterior, alkyd enamel in colors in accordance with ASME A13.1 unless otherwise indicated. Paint may be in pressurized spray-can form.
6. Letter and Background Color: As indicated for specific application under Part 3.

2.6 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Brady Corporation.

B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.04-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass link chain or beaded chain.

C. Letter and Background Color: As indicated for specific application under Part 3.

D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Include valve-tag schedule in operation and maintenance data.

2.7 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Brady Corporation.
- B. Description: Preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
 1. Size: 3 by 5-1/4 inches minimum.
 2. Fasteners: Brass grommet and wire.
 3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 4. Letter and Background Color: As indicated for specific application under Part 3.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of plumbing equipment.
- B. Sign and Label Colors.
 1. White letters on an ANSI Z535.1 safety-green background.
- C. Locate equipment labels where accessible and visible.

3.4 INSTALLATION OF WARNING TAPE

- A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes.

- B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. of clearance.
- C. Locate tape so as to be readily visible from the point of normal approach.

3.5 INSTALLATION OF PIPE LABELS

- A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- B. Stenciled Pipe Label Option: Stenciled labels showing service and flow direction may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- C. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Within 3 ft. of each valve and control device.
 - 2. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 3. Within 3 ft. of equipment items and other points of origination and termination.
 - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.
- D. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- E. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- F. Pipe-Label Color Schedule:
 - 1. Domestic Cold-Water Piping: White letters on an ANSI Z535.1 safety-green background.
 - 2. Domestic Hot-Water Piping: White letters on an ANSI Z535.1 safety-green background.
 - 3. Domestic Hot-Water Return Piping: White letters on an ANSI Z535.1 safety-green background.
 - 4. Sanitary Waste and Storm Drainage Piping: White letters on a black background.

3.6 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.

- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:

1. Valve-Tag Size and Shape:

- a. Domestic Cold Water: 1-1/2 inches round.
- b. Domestic Hot Water: 1-1/2 inches round.
- c. Domestic Hot-Water Return: 1-1/2 inches round.

2. Valve-Tag Colors:

- a. For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.

3.7 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.
- B. Attach warning tags, with proper message, to equipment and other items where indicated on drawings.

END OF SECTION 220553

SECTION 220593 - TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. TAB of domestic water system.
2. TAB of plumbing equipment:
 - a. Domestic hot-water in-line circulation pumps.
 - b. General-duty air compressors.
3. Pipe-leakage test verification.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- C. Certified TAB reports.
- D. Sample report forms.
- E. Instrument calibration reports, to include the following:
1. Instrument type and make.

2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.4 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by NEBB or TABB:
 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
 2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.
- B. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- C. ASHRAE 111 Compliance: Requirements in ASHRAE 111 applicable to analogous domestic water system and plumbing equipment balancing.
- D. ASHRAE 188 Compliance: Comply with balancing and report requirements, Section 8.3 "Balancing."
- E. Code and Authorities Having Jurisdiction Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

PART 2 - EXECUTION

2.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine approved submittals for plumbing systems and equipment.
- D. Examine design data, including plumbing system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about plumbing system and equipment controls.
- E. Examine equipment performance data, including pump curves.
 1. Relate performance data to Project conditions and requirements, including pump system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

2. Calculate pump system-effect factors to reduce performance ratings of plumbing equipment when installed under conditions different from the conditions used to rate equipment performance. Compare results with the design data and installed conditions.
- F. Examine system and equipment installations, and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine plumbing equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- I. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.
- J. Examine system pumps to ensure absence of entrained air in the suction piping.
- K. Examine operating safety interlocks and controls on plumbing equipment.
- L. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

2.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
 1. Equipment and systems to be tested.
 2. Strategies and step-by-step procedures for balancing the systems.
 3. Instrumentation to be used.
 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of plumbing systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 1. Domestic Water System:
 - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed in accordance with applicable code and authority having jurisdiction.
 - b. Water heaters are installed and functioning.
 - c. Piping is complete and all points of outlet are installed.
 - d. Water treatment is complete.
 - e. Systems are flushed, filled, and air purged.
 - f. Strainers are clean.
 - g. Control valves are functioning in accordance with the sequence of operation.
 - h. Shutoff and balance valves are 100 percent open.
 - i. Hot-water circulating pumps are operational and proper rotation is verified.

- j. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
 - k. Variable-frequency controllers' startup is complete and safeties are verified.
 - l. Suitable access to balancing devices and equipment is provided.
- 2. Sanitary Sewage/Drainage System:
 - a. Leakage and pressure tests on sanitary sewage/drainage systems have been completed in accordance with applicable code and authority having jurisdiction requirements.
 - b. Piping is complete.
 - c. Sanitary sewage pumps/drainage pumps are operational.
 - d. Control valves are functioning in accordance with the sequence of operation.
 - e. Shutoff valves are 100 percent open.
 - f. Suitable access to equipment is provided.
- 3. Compressed-Air System:
 - a. Leakage and pressure tests on compressed air distribution system have been satisfactorily completed in accordance with Division 22 requirements.
 - b. Piping is complete and all points of outlet are installed.
 - c. Systems are flushed, filled, and air purged.
 - d. Strainers are clean.
 - e. Control valves are functioning in accordance with the sequence of operation.
 - f. Shutoff and balance valves are 100 percent open.
 - g. Compressors are operational and of proper rotation.
 - h. Gauge connections are installed directly at compressor inlet and outlet flanges prior to valves or strainers.
 - i. Variable-frequency controllers' startup is complete and safeties are verified.
 - j. Suitable access to balancing devices and equipment is provided,

2.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in AABC's "National Standards for Total System Balance", NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. Where holes for probes are required in piping or equipment, install pressure and temperature test plugs to seal systems.
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 220716 "Plumbing Equipment Insulation" and Section 220719 "Plumbing Piping Insulation."

- C. Mark equipment and balancing devices, including valve position indicators and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

2.4 GENERAL PROCEDURES FOR PLUMBING EQUIPMENT

- A. Test, adjust, and balance plumbing equipment indicated on Drawings, including, but not limited to, the following:
 - 1. Domestic water in-line pumps.
 - 2. Domestic water heaters.
 - 3. Air compressors.

2.5 PROCEDURES FOR DOMESTIC WATER SYSTEMS

- A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.
- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:
 - 1. Check expansion tank for proper setting.
 - 2. Check water heater for proper discharge temperature setting.
 - 3. Check remotest point of outlet for adequate pressure.
 - 4. Check flow-control valves for proper position.
 - 5. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
 - 6. Verify that motor controllers are equipped with properly sized thermal protection.
 - 7. Check that air has been purged from the system.
- D. Measure and record upstream and downstream pressure of each piece of equipment.
- E. Measure and record upstream and downstream pressure of pressure-reducing valves.
- F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
- G. Check settings and operation of each safety valve. Record settings.

2.6 PROCEDURES FOR COMPRESSED-AIR SYSTEMS

- A. Prepare test reports for air compressors, and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.
- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare compressed-air systems for testing and balancing as follows:
 - 1. Check remotest point of outlet for adequate pressure.
 - 2. Check pressure-control valves for proper position.
 - 3. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
 - 4. Verify that motor controllers are equipped with properly sized thermal protection.
- D. Measure and record upstream and downstream pressure of pressure-reducing valves.
- E. Check settings and operation of pressure-reducing valves. Record final settings.
- F. Check settings and operation of each safety valve. Record settings.

2.7 PROCEDURES FOR DOMESTIC HOT-WATER CIRCULATING INLINE PUMP

- A. Balance system with manual or automatic balancing valves by setting at design flow.
 - 1. Measure flow in main and branch pipes.
 - 2. Adjust main and branch balance valves for design flow.
 - 3. Re-measure each main and branch after all have been adjusted.
- B. Adjust pump to deliver total design flow.
 - 1. Measure pump TDH as follows:
 - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
 - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
 - c. Convert pressure to head and correct for differences in gauge heights.
 - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
 - 2. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
 - 3. Mark final settings and verify that all memory stops have been set.
 - 4. Verify final system conditions as follows:
 - a. Re-measure and confirm that total flow is within design.

- b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
- c. Mark final settings.

2.8 PROCEDURES FOR WATER HEATERS

A. Gas- and Oil-Fired Water Heaters:

- 1. Measure and record entering- and leaving-water temperatures.
- 2. Measure and record water flow.
- 3. Measure and record pressure drop.
- 4. Measure and Record relief valve(s) pressure setting.
- 5. Capacity: Calculate in Btu/h of heating output.
- 6. Fuel Consumption: If fuel supply is equipped with flow meter, measure and record consumption.
- 7. Efficiency: Calculate operating efficiency for comparison to submitted equipment.
- 8. Fan, motor, and motor controller operating data.

2.9 TOLERANCES

A. Set plumbing system's flow rates within the following tolerances:

- 1. Domestic Water Flow Rate: Plus or minus 5 percent. If design value is less than 10 gpm , within 10 percent.
- 2. Compressed-Air Flow Rate: Plus or minus 5 percent. If design value is less than 10 gpm , within 10 percent.

2.10 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

- 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
- 2. Include a list of instruments used for procedures, along with proof of calibration.
- 3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

- 1. Pump curves.
- 2. Manufacturers' test data.
- 3. Field test reports prepared by system and equipment installers.
- 4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.
2. Name and address of the TAB specialist.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB supervisor who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents, including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Notes to explain why certain final data in the body of reports vary from indicated values.
14. Test conditions for pump performance forms, including the following:
 - a. Variable-frequency controller settings for variable-flow hydronic systems.
 - b. Settings for pressure controller(s).
 - c. Other system operating conditions that affect performance.

D. Instrument Calibration Reports:

1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

2.11 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Commissioning Authority.
- B. Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.
- E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
 - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
 - 2. If the second final inspection also fails, Owner may pursue other Contract options to complete TAB work.
- F. Prepare test and inspection reports.

END OF SECTION 220593

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. PVC pipe and fittings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and elevations, or Building Information Model (BIM) drawn to scale, showing items described in this Section and coordinated with all building trades.
- B. Field quality-control reports.

1.4 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10 ft. head of water

2.2 PIPING MATERIALS

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 PVC PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or equal:
 - 1. Charlotte Pipe and Foundry Company.
 - 2. JM Eagle.
 - 3. National Pipe & Plastics; a CRH Company.
 - 4. North America Pipe Corporation.
- B. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.
- C. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- D. Adhesive Primer: ASTM F656.
- E. Solvent Cement: ASTM D2564.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 - 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. 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.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.

- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 - 2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.
 - 3. Do not change direction of flow more than 90 degrees.
 - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
 - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 3. Maintain swab in piping and pull past each joint as completed.
- L. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- M. Install aboveground PVC piping in accordance with ASTM D2665.
- N. Install underground PVC piping in accordance with ASTM D2321.
- O. Install engineered soil and waste and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- P. Plumbing Specialties:
 - 1. Install backwater valves in sanitary waster gravity-flow piping.
 - a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."

2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 - a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
 - b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
 3. Install drains in sanitary waste gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- R. Install sleeves for piping penetrations of walls, ceilings, and floors.
 1. Comply with requirements for sleeves specified in Section 220500 "Common Work Results for Plumbing."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs.
 1. Comply with requirements for sleeve seals specified in Section 220500 "Common Work Results for Plumbing."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 1. Comply with requirements for escutcheons specified in Section 220500 "Common Work Results for Plumbing."

3.3 JOINT CONSTRUCTION

- A. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- B. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. ABS Piping: Join in accordance with ASTM D2235 and ASTM D2661 appendixes.
 3. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.

3.4 INSTALLATION OF VALVES

- A. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
2. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.5 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment"
 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 2. Install stainless steel pipe hangers for horizontal piping in corrosive environments.
 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
 5. Vertical Piping: MSS Type 8 or Type 42 clamps.
 6. Install individual, straight, horizontal piping runs:
 - a. 100 Ft. (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Ft. (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Ft. (30 m) if Indicated: MSS Type 49, spring cushion rolls.
 7. Multiple, Straight, Horizontal Piping Runs 100 Ft. (30 m) or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
 8. Base of Vertical Piping: MSS Type 52 spring hangers.
- B. Install hangers for PVC piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- D. Support vertical runs of PVC piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.

4. Comply with requirements for backwater valves, cleanouts and drains specified in Section 221319 "Sanitary Waste Piping Specialties."
5. Equipment: Connect waste piping as indicated.
 - a. Provide shutoff valve if indicated and union for each connection.
 - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections in accordance with the following unless otherwise indicated:
 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than 10 ft. head of water.
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
 - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1 inch wg.
 - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
 - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - d. Inspect plumbing fixture connections for gas and water leaks.
 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 6. Prepare reports for tests and required corrective action.
- E. Test force-main piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
 - a. Isolate test source and allow to stand for four hours.
 - b. Leaks and loss in test pressure constitute defects that must be repaired.
 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 4. Prepare reports for tests and required corrective action.

3.9 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.

- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed Plastic Piping: Protect PVC plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.10 PIPING SCHEDULE

- A. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller are to be the following:
 - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- B. Aboveground, soil and waste piping NPS 5 (DN 125) and larger are to be the following:
 - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- C. Aboveground, vent piping NPS 4 (DN 100) is to be the following:
 - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- D. Aboveground, vent piping NPS 5 (DN 125) and larger is to be the following:
 - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- E. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller are to be the following:
 - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- F. Underground, soil and waste piping NPS 5 (DN 125) and larger are to be the following:
 - 1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION 221316

SECTION 221319 – SANITARY WASTE PIPING SPECIALITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Miscellaneous sanitary drainage piping specialties.

1.2 DEFINITIONS

- A. ABS: Acrylonitrile butadiene styrene.
- B. PVC: Polyvinyl chloride.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
1. Show fabrication and installation details for frost-resistant vent terminals.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For sanitary waste piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 CLEANOUTS

A. Cast-Iron Exposed Floor Cleanouts:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or equal:
 - a. MIFAB, Inc.
 - b. WATTS; A Watts Water Technologies Company.
 - c. Zurn Industries, LLC.
- 2. Standard: ASME A112.36.2M for adjustable housing cleanout.
- 3. Size: Same as connected branch.
- 4. Type: Adjustable housing.
- 5. Body or Ferrule: Cast iron.
- 6. Clamping Device: Not required.
- 7. Outlet Connection: Spigot.
- 8. Closure: Cast-iron plug.
- 9. Adjustable Housing Material: Cast iron with setscrews or other device.
- 10. Frame and Cover Material and Finish: Painted cast iron.
- 11. Frame and Cover Shape: Round.
- 12. Top-Loading Classification: Heavy Duty.
- 13. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.

B. Cast-Iron Wall Cleanouts:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following, or equal:
 - a. MIFAB, Inc.
 - b. WATTS; A Watts Water Technologies Company.
 - c. Zurn Industries, LLC.
- 2. Standard: ASME A112.36.2M. Include wall access.
- 3. Size: Same as connected drainage piping.
- 4. Body: as required to match connected piping.
- 5. Closure Plug:
 - a. Brass.

- b. Countersunk head.
 - c. Drilled and threaded for cover attachment screw.
 - d. Size: Same as or not more than one size smaller than cleanout size.
- 6. Wall Access, Cover Plate: Round, flat, chrome-plated brass or stainless steel cover plate with screw.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings :

- 1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
- 2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

B. Air-Gap Fittings :

- 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
- 2. Body: Bronze or cast iron.
- 3. Inlet: Opening in top of body.
- 4. Outlet: Larger than inlet.
- 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Frost-Resistant Vent Terminals :

- 1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
- 2. Design: To provide 1-inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backwater valves in building drain piping.

- 1. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

- 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
- 2. Locate at each change in direction of piping greater than 45 degrees.

3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 2. Size: Same as floor drain inlet.
- F. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- G. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- H. Install vent caps on each vent pipe passing through roof.
- I. Install frost-resistant vent terminals on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- J. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- K. Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1-inch clearance between vent pipe and roof substrate.
- L. Install wood-blocking reinforcement for wall-mounting-type specialties.
- M. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 PIPING CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
 - 1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221319.13 - SANITARY DRAINS

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Floor drains.
 - 2. Floor sinks.
 - 3. Trench drains.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene styrene.
- B. HDPE: High-density polyethylene.
- C. PVC: Polyvinyl chloride.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

- A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2 FLOOR DRAINS

- A. Cast-Iron Floor Drains <FD-1>:
 - 1. **<Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. [WATTS; A Watts Water Technologies Company.](#)
 - b. [Zurn Industries, LLC.](#)
2. Standard: ASME A112.6.3 with backwater valve.
 3. Pattern: Floor drain.
 4. Body Material: Cast Iron
 5. Seepage Flange: Not required.
 6. Anchor Flange: Required.
 7. Clamping Device: Required.
 8. Outlet: Bottom.
 9. Backwater Valve: Integral, ASME A112.14.1, swing-check type.
 10. Coating on Interior and Exposed Exterior Surfaces: Epoxy Coated.
 11. Sediment Bucket: Not required.
 12. Top or Strainer Material: Nickel bronze.
 13. Top of Body and Strainer Finish: Nickel bronze
 14. Top Shape: Round.
 15. Dimensions of Top or Strainer: 5in. Dia. nickel bronze strainer.
 16. Top Loading Classification: Medium Duty.
 17. Funnel: Not required.
 18. Trap Material: DWV PVC.
 19. Trap Pattern: Standard P-trap.
 20. Trap Features: Trap-seal primer valve drain connection.

2.3 FLOOR SINKS

A. Cast-Iron Floor Sinks <FS-1>:

1. [<Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
 - a. [WATTS; A Watts Water Technologies Company.](#)
 - b. [Zurn Industries, LLC.](#)
2. Standard: ASME A112.6.7.
3. Pattern: Floor drain.
4. Body Material: Cast iron.
5. Anchor Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom, no-hub connection.
8. Coating on Interior Surfaces: Acid-resistant enamel.
9. Sediment Bucket: Not required.
10. Internal Strainer: Dome.
11. Internal Strainer Material: ABS.
12. Top Grate Material: Cast iron.
13. Top of Body and Grate Finish: Enameled Cast Iron.
14. Top Shape: Square.
15. Dimensions of Top Grate: 3/4 Grate for 8 x 8 Floor Sink.

16. Top Loading Classification: No traffic.
17. Funnel: Not required.

B. Cast-Iron Floor Sinks <FS-2>:

1. <Manufacturers>: Subject to compliance with requirements, provide products by one of the following:
 - a. WATTS; A Watts Water Technologies Company.
 - b. Zurn Industries, LLC.
2. Standard: ASME A112.6.7.
3. Pattern: Floor drain.
4. Body Material: Cast iron.
5. Anchor Flange: Required.
6. Clamping Device: Required.
7. Outlet: Bottom, no-hub connection.
8. Coating on Interior Surfaces: Acid-resistant enamel.
9. Sediment Bucket: Not required.
10. Internal Strainer: Dome.
11. Internal Strainer Material: ABS.
12. Top Grate Material: Cast iron.
13. Top of Body and Grate Finish: Enameled Cast Iron.
14. Top Shape: Square.
15. Dimensions of Top Grate: 3/4 Grate for 12 x 12 Floor Sink.
16. Top Loading Classification: No traffic.
17. Funnel: Not required.

2.4 TRENCH DRAINS

A. Trench Drains <TD-1>:

1. <Manufacturers>: Subject to compliance with requirements, provide products by one of the following, or equal:
 - a. MIFAB, Inc.
 - b. Zurn Industries, LLC.
2. Standard: ASME A112.6.3 for trench drains.
3. Material: HDPE.
4. Flange: Anchor.
5. Clamping Device: Required.
6. Outlet: Bottom.
7. Grate Material: Ductile Iron
8. Grate Finish: Black Acid Resistant Epoxy Coated
9. Dimensions of Frame and Grate: 80" Long, 6-1/4" Wide Reveal, 4" Throat, 5-3/8" Wide Reveal Slotted Grate
10. Top Loading Classification: Class C

11. Trap Material: PVC.
12. Trap Pattern: Standard P-trap.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
 3. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
 - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
 - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
 4. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
 - a. Maintain integrity of waterproof membranes where penetrated.
 5. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- B. Install trench drains at low points of surface areas to be drained.
 1. Set grates of drains flush with finished surface, unless otherwise indicated.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Comply with requirements in Section 221319 "Sanitary Waste Piping Specialties" for backwater valves, air admittance devices and miscellaneous sanitary drainage piping specialties.
- C. Install piping adjacent to equipment to allow service and maintenance.
- D. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

- E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319.13

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Electrical equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Grout.
 - 4. Common electrical installation requirements.
 - 5. Record documents.
 - 6. Maintenance manuals.
 - 7. Delivery, storage, handling.
 - 8. Rough-in.
 - 9. Cutting and patching.
 - 10. Quality assurance.
 - 11. Permits and regulations.

1.3 COORDINATION

- 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 installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

1.4 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 1 Section "Project Closeout". In addition to the requirements specified in Division 1, indicate installed conditions for:
 - 1. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; and fuse and circuit breaker size and arrangements.
 - 2. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
 - 3. Approved substitutions, Contract Modifications, and actual equipment and materials installed.

1.5 MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with Division 1 Section "Project Closeout". In addition to the requirements specified in Division 1, include the following information for equipment items:
 - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
 - 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
 - 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
 - 4. Servicing instructions and lubrication charts and schedules.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

PART 2 - PRODUCTS

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.

2.2 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 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Unless otherwise noted, 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 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.

- E. Right of Way: Give to piping systems installed at a required slope.
- F. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- G. Coordinate electrical systems, equipment, and materials installation with other building components.
- H. Verify all dimensions by field measurements.
- I. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
- J. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
- K. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
- L. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
- M. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
- N. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
- O. Install access panel or doors where units are concealed behind finished surfaces.
- P. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
- Q. Install all lighting fixtures with independent supports.
 - 1. Each fixture shall be independently supported with wire, chain, cable or threaded rod from the building structure.
 - a. Surface mounted fixtures shall be supported from a fixture stud in the raceway system lighting outlet box.
 - b. Lighting outlet boxes shall be independently supported from the structure with threaded rods.
 - c. Recessed lighting fixtures shall be directly supported from the building structure and independent of the suspended ceiling system. Support may be accomplished with zinc coated steel wire or cable. The fixtures shall be secured to the suspended ceiling-framing members with approved clips or screws.
 - d. Fixtures supported free of lighting outlet boxes, (i.e. cable or pendent hung) shall be done with fixture hardware specifically designed for the fixture being installed. This fixture hardware shall be supported, above the ceiling, from the building structure.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. 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.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Size pipe sleeves to provide manufacturer's recommended annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- G. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
- I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.
- J. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- K. Aboveground, Exterior-Wall Penetrations: Seal penetrations with grout.

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.

3.4 PERMITS AND REGULATIONS

- A. The electrical installation shall meet the requirements of the National Electrical Code. In addition, any state, municipal, or other authority laws, rules, or regulations applicable to the work, shall be followed.
- B. The Contractor shall furnish and file with the proper authorities all drawings required by them in connection with this work. He shall obtain all official permits, licenses and inspections and shall pay all legal and proper fees and charges in this connection.
- C. Should any work shown or specified be of lighter or smaller material than the code and regulations require, same shall be executed in strict accordance with applicable codes or regulations. Example: If plans show 3 inches and codes call for 4 inches, install 4 inches.

- D. Heavier or larger size material than the code requires shall be furnished and installed as called for by these specifications and/or drawings.
- E. The Contractor shall have the electrical work inspected from time to time by authorized inspectors and shall pay all expense incurred by same. At the completion of the work, the Contractor shall furnish a certificate of inspection, acceptable to the authority having jurisdiction, in triplicate indicating full approval of the work furnished and installed in this contract. Where applicable, all materials and equipment shall bear the label of approval of Underwriter's Laboratories. All devices shall be installed in accordance with UL requirements.

3.5 CUTTING AND PATCHING

- A. General: Perform cutting and patching in accordance with the following requirements:
 - 1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
 - a. Uncover work too provide for installation of ill-timed work.
 - b. Remove and replace defective work.
 - c. Remove and replace work not conforming to requirements of the Contract Documents.
 - d. Remove samples of installed work as specified for testing.
 - e. Install equipment and materials in existing structures.
 - f. Upon written instructions from the Architect, uncover and restore work to provide for Architect observation of concealed work.
 - 2. Cut, remove, and legally dispose of selected electrical equipment, components, and materials as indicated, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new work.
 - 3. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
 - 4. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
 - 5. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
 - 6. Patch finished surfaces and building components using new materials specified for the original installation and experienced Installers. For existing surfaces and building components, use new materials matching existing materials. Installer's qualifications refer to the materials and methods required for the surface and building components being patched.

3.6 QUALITY ASSURANCE

- A. Comply with NFPA 70 "National Electrical Code" for components and installation.

END OF SECTION 260500

SECTION 260513 - MEDIUM-VOLTAGE CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes cables and related cable splices, terminations, and accessories for medium-voltage (2001 to 35,000 V) electrical distribution systems.

1.3 DEFINITIONS

- A. Jacket: A continuous nonmetallic outer covering for conductors or cables.
- B. NETA ATS: Acceptance Testing Specification.
- C. Sheath: A continuous metallic covering for conductors or cables.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cable. Include splices and terminations for cables and cable accessories.
- B. Samples: 16-inch (400-mm) lengths for each type of cable specified.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **testing agency**.
- B. Material Certificates: For each type of cable and accessory.
- C. Source quality-control reports.
- D. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Installer: Engage a cable splicer, trained and certified by splice material manufacturer, to install, splice, and terminate medium-voltage cable.
- B. Testing Agency Qualifications: Member company of NETA or an NRTL.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 FIELD CONDITIONS

- A. 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:
 - 1. Notify **Owner** no fewer than seven days in advance of proposed interruption of electric service.
 - 2. Do not proceed with interruption of electric service **Owner's** written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, **provide products by one of the available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:**
 - 1. Cables:
 - a. Aetna Insulated Wire, Inc.; a Berkshire Hathaway company.
 - b. General Cable Technologies Corporation.
 - c. Kerite; a Marmon Wire & Cable/Berkshire Hathaway company.
 - d. Okonite Company (The).
 - e. Prysmian Cables & Systems.
 - f. Southwire Company.
 - 2. Cable Splicing and Terminating Products and Accessories:
 - a. Adalet; a Scott Fetzer company.
 - b. DSG-Canusa; a Shawcor company.
 - c. Engineered Products Company.
 - d. G&W Electric Company.
 - e. MP Husky.
 - f. RTE Components; Cooper Power Systems, Inc.
 - g. Thomas & Betts Corporation.
 - h. Thomas & Betts Corporation/Elastimold.
 - i. 3M; Electrical Markets Division.

j. Tyco Electronics; Raychem Products.

- B. Source Limitations: Obtain cables and accessories from single source from single manufacturer.

2.2 SYSTEM DESCRIPTION

- 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. Comply with IEEE C2 and NFPA 70.

2.3 CABLES

- A. Cable Type: **Type MV 105.**
- B. Comply with UL 1072, AEIC CS8, **ICEA S-97-682**
- C. Conductor: **Copper**
- D. Conductor Stranding: **Compact round, concentric lay, Class B**
- E. Conductor Insulation: **Ethylene-propylene rubber.**
1. Voltage Rating:
a. 15kV
2. Insulation Thickness: **133** percent insulation level.
- F. Shielding: **Copper tape**, helically applied over semiconducting insulation shield.
- G. Cable Jacket: **Sunlight-resistant PVC**

2.4 CONNECTORS

- A. Comply with ANSI C119.4 for connectors between aluminum conductors or for connections between aluminum to copper conductors.
- B. Copper-Conductor Connectors: Aluminum **barrel crimped** connectors.

2.5 SOLID TERMINATIONS

- A. Shielded-Cable Terminations: Comply with the following classes of IEEE 48. Insulation class shall be equivalent to that of cable. Include shield ground strap for shielded cable terminations.

1. Class 1 Terminations: Modular type, furnished as a kit, with stress-relief tube; multiple, molded-silicone-rubber, insulator modules; shield ground strap; and compression-type connector.
2. Class 1 Terminations: Heat-shrink type with heat-shrink inner stress control and outer nontracking tubes; multiple, molded, nontracking skirt modules; and compression-type connector.
3. Class 1 Terminations: Modular type, furnished as a kit, with stress-relief shield terminator; multiple-wet-process, porcelain, insulator modules; shield ground strap; and compression-type connector.
4. Class 1 Terminations, Indoors: Kit with stress-relief tube, nontracking insulator tube, shield ground strap, compression-type connector, and end seal.

2.6 SEPARABLE INSULATED CONNECTORS

- A. Description: Modular system, complying with IEEE 386, with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.
- B. Dead-Break Cable Terminators: Elbow-type unit with **200A and/or 600A** as indicated continuous-current rating; designed for de-energized disconnecting and connecting; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.

2.7 SPLICE KITS

- A. Splice Kits: Comply with IEEE 404; type as recommended by cable or splicing kit manufacturer for the application.
- B. Splicing Products: As recommended, in writing, by splicing kit manufacturer for specific sizes, materials, ratings, and configurations of cable conductors. Include all components required for complete splice, with detailed instructions.
 1. Combination tape and cold-shrink-rubber sleeve kit with re-jacketing by cast-epoxy-resin encasement or other waterproof, abrasion-resistant material.
 2. Heat-shrink splicing kit of uniform, cross-section, polymeric construction with outer heat-shrink jacket.
 3. Premolded, cold-shrink-rubber, in-line splicing kit.
 4. Premolded, EPDM splicing body kit with cable joint sealed by interference fit of mating parts and cable.
 5. Separable multiway splice system with all components for the required splice configuration.

2.8 MEDIUM-VOLTAGE TAPES

- A. Ethylene/propylene rubber-based, **30-mil (0.76-mm)** splicing tape, rated for 130 deg C operation. Minimum **3/4 inch (20 mm)** wide.

- B. Silicone rubber-based, **12-mil (0.30-mm)** self-fusing tape, rated for 130 deg C operation. Minimum 1-1/2 inches (38 mm) wide.
- C. Insulating-putty, **125-mil (3.175-mm)** elastic filler tape. Minimum **1-1/2 inches (38 mm)** wide.

2.9 ARC-PROOFING MATERIALS

- A. Tape for First Course on Metal Objects: **10-mil- (250-micrometer-)** thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape.
- B. Arc-Proofing Tape: Fireproof tape, flexible, conformable, intumescent to **0.3 inch (8 mm)** thick, and compatible with cable jacket.
- C. Glass-Cloth Tape: Pressure-sensitive adhesive type, **1 inch (25 mm)** wide.

2.10 SOURCE QUALITY CONTROL

- A. Test and inspect cables according to **ICEA S-97-682** before shipping.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cables according to IEEE 576.
- B. Proof conduits prior to conductor installation by passing a wire brush mandrel and then a rubber duct swab through the conduit. Separate the wire brush and the rubber swab by **48 to 72 inches (1200 to 1800 mm)** on the pull rope.
 - 1. Wire Brush Mandrel: Consists of a length of brush approximately the size of the conduit inner diameter with stiff steel bristles and an eye on each end for attaching the pull ropes. If an obstruction is felt, pull the brush back and forth repeatedly to break up the obstruction.
 - 2. Rubber Duct Swab: Consists of a series of rubber discs approximately the size of the conduit inner diameter on a length of steel cable with an eye on each end for attaching the pull ropes. Pull the rubber duct swab through the duct to extract loose debris from the duct.
- C. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
 - 1. Where necessary, use manufacturer-approved pulling compound or lubricant that does not deteriorate conductor or insulation.
 - 2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips, that do not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.

3. Use pull-in guides, cable feeders, and draw-in protectors as required to protect cables during installation.
 4. Do not pull cables with ends unsealed. Seal cable ends with rubber tape.
- D. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- E. Install "buried-cable" warning tape **12 inches (305 mm)** above cables.
- F. In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit; support cables at intervals adequate to prevent sag.
- G. Install sufficient cable length to remove cable ends under pulling grips. Remove length of conductor damaged during pulling.
- H. Install cable splices at pull points and elsewhere as indicated; use standard kits
- I. Install terminations at ends of conductors, and seal multiconductor cable ends with standard kits.
- J. Install separable insulated-connector components as follows:
1. Protective Cap: At each terminal junction, with one on each terminal to which no feeder is indicated to be connected.
 2. Portable Feed-Through Accessory: At each terminal junction, with one on each terminal.
 3. Standoff Insulator: At each terminal junction, with one on each terminal.
- K. Arc Proofing: Unless otherwise indicated, arc proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial, or termination materials. In addition to arc-proofing tape manufacturer's written instructions, apply arc proofing as follows:
1. Clean cable sheath.
 2. Wrap metallic cable components with **10-mil (250-micrometer)** pipe-wrapping tape.
 3. Smooth surface contours with electrical insulation putty.
 4. Apply arc-proofing tape in one half-lapped layer with coated side toward cable.
 5. Band arc-proofing tape with two layers of **1-inch- (25-mm-)** wide half-lapped, adhesive, glass-cloth tape at each end of the arc-proof tape.
- L. Seal around cables passing through fire-rated elements according to Section 078413 "Penetration Firestopping."
- M. Ground shields of shielded cable at one point only. Maintain shield continuity and connections to metal connection hardware at all connection points.
- N. Identify cables according to Section 260553 "Identification for Electrical Systems." Identify phase and circuit number of each conductor at each splice, termination, pull point, and junction box. Arrange identification so that it is unnecessary to move the cable or conductor to read the identification.

3.2 FIELD QUALITY CONTROL

- A. Testing Agency: **Engage** a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections **with the assistance of a factory-authorized service representative**:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
 - 2. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.
- D. Medium-voltage cables will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 260513

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Burndy; Part of Hubbell Electrical Systems.
 - 2. ERICO International Corporation.
 - 3. ILSCO.
 - 4. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.

2.2 SYSTEM DESCRIPTION

- 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. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-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. Tinned Conductors: ASTM B 33.

4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL 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.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

PART 3 - EXECUTION

3.1 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. 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.
- C. Conductor Terminations and Connections:
 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 2. Underground Connections: Welded connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 1. Feeders and branch circuits.
 2. Lighting circuits.
 3. Receptacle circuits.
 4. Single-phase motor and appliance branch circuits.
 5. Three-phase motor and appliance branch circuits.
 6. Flexible raceway runs.
 7. Armored and metal-clad cable runs.

3.3 INSTALLATION

- A. 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.

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. 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.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.

1.6 QUALITY ASSURANCE

- A. Comply with NFPA 70.

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. Cooper B-Line, Inc.; a division of Cooper Industries.
 - b. ERICO International Corporation.
 - c. Unistrut; an Atkore International company.
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. 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 and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- E. 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.
 - 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.
 - 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.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 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 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 support system.
 - 1. Secure raceways and cables to these supports with 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.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. 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.
- D. 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 or Spring-tension clamps.
 - 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.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

3.4 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. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits, tubing, and fittings.
 - 2. Surface raceways.
 - 3. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Allied Tube & Conduit.
 - 2. Republic Conduit.
 - 3. Western Tube and Conduit Corporation.
 - 4. Wheatland Tube Company.
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. EMT: Comply with ANSI C80.3 and UL 797.

- E. FMC: Comply with UL 1; zinc-coated steel or aluminum.
- F. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Setscrew or compression.
- H. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Wiremold / Legrand.

2.3 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. EGS/Appleton Electric.
 - 2. Hoffman; a brand of Pentair Equipment Protection.
 - 3. Hubbell Incorporated.
 - 4. Kraloy.
 - 5. Oldcastle Enclosure Solutions.
 - 6. O-Z/Gedney; an EGS Electrical Group brand; an Emerson Industrial Automation business.
 - 7. RACO; Hubbell.
 - 8. Thomas & Betts Corporation, A Member of the ABB Group.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

- E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- I. Device Box Dimensions: 4 inches square by 1-1/2 inches deep minimum.
- J. Gangable boxes are allowed.
- K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed Conduit: GRC.
 - 2. Concealed Conduit, Aboveground: GRC.
 - 3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 - 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Exposed and Subject to Physical Damage: GRC.
 - 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. Damp or Wet Locations: GRC.
 - 6. Boxes and Enclosures: NEMA 250, Type 1.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 - 1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
 - 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Do not install surface raceways unless all other methods of raceway concealment have been exhausted.

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. 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.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- 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. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- M. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- N. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

- O. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- P. 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. Cap underground raceways designated as spare above grade alongside raceways in use.
- Q. Surface Raceways:
 - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
 - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- R. Install raceway sealing fittings at accessible locations according to NFPA 70 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 according to NFPA 70.
- S. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations.
 - 2. Where otherwise required by NFPA 70.
- T. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations.
- U. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- V. 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. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- W. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- X. Locate boxes so that cover or plate will not span different building finishes.
- Y. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- Z. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

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TA PROJECT #24003

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

3.4 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION 260533

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. Direct-buried conduit, ducts, and duct accessories.
 - 2. Concrete-encased conduit, ducts, and duct accessories.
 - 3. Handholes and boxes.

1.3 DEFINITIONS

- A. Traffic ways: Locations where vehicular or pedestrian traffic is a normal course of events.
- B. Manhole: For the purpose of this specifications manhole and handhole are synonymous terms and may be used interchangeably.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Duct-bank materials, including separators and miscellaneous components.
 - 2. Ducts and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
 - 3. Accessories for handholes, boxes,
 - 4. Warning tape.
- B. Shop Drawings:
 - 1. Precast or Factory-Fabricated Underground Utility Structures:
 - a. Include plans, elevations, sections, details, attachments to other work, and accessories.
 - b. Include duct entry provisions, including locations and duct sizes.
 - c. Include reinforcement details.
 - d. Include frame and cover design and manhole frame support rings.
 - e. Include step details.
 - f. Include grounding details.
 - g. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
 - h. Include joint details.

2. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:

- a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
- b. Include duct entry provisions, including locations and duct sizes.
- c. Include cover design.
- d. Include grounding details.
- e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.5 INFORMATIONAL SUBMITTALS

- A. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
 - 1. Include plans and sections, drawn to scale, and show bends
- B. Product Certificates: For concrete and steel used in precast concrete handholes, as required by ASTM C 858.
- C. Source quality-control reports.
- D. Field quality-control reports.

1.6 MAINTENANCE MATERIALS SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Furnish cable-support stanchions, arms, and associated fasteners in quantities equal to 5 percent of quantity of each item installed.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.
- B. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
- C. Lift and support precast concrete units only at designated lifting or supporting points.

1.9 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Owner no fewer than two days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.
- B. Ground Water: Assume ground-water level is 36 inches (900 mm below ground surface unless a higher water table is noted on Drawings.

1.10 COORDINATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR DUCTS AND RACEWAYS

- A. Comply with ANSI C2.
- B. Comply with NFPA 70.

2.2 CONDUIT

- A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.
- B. RNC: NEMA TC 2, Type EPC-40-PVC and Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.3 NONMETALLIC DUCTS AND DUCT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. ARNCO Corp.
 - 2. Beck Manufacturing.
 - 3. CANTEX INC.
 - 4. CertainTeed Corporation.
 - 5. Condux International, Inc.

6. ElecSys, Inc.
 7. Electri-Flex Company.
 8. IPEX USA LLC.
 9. Lamson & Sessions.
 10. Manhattan/CDT.
 11. Spiraduct/AFC Cable Systems, Inc.
- B. Underground Plastic Utilities Duct: NEMA TC 2, UL 651, ASTM F 512, Type EPC-80 and Type EPC-40, with matching fittings complying with NEMA TC 3 by same manufacturer as the duct.
- C. Solvents and Adhesives: As recommended by conduit manufacturer.
- D. Duct Accessories:
1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and size of ducts with which used, and selected to provide minimum duct spacing indicated while supporting ducts during concreting or backfilling.
 2. Warning Tape: Underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."

2.4 PRECAST CONCRETE HANDHOLES AND BOXES

- A. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Christy Concrete Products.
 2. Elmhurst-Chicago Stone Co.
 3. Oldcastle Precast, Inc.
 4. Rinker Group, Ltd.
 5. Riverton Concrete Products.
 6. Utility Concrete Products, LLC.
 7. Utility Vault Co.
 8. Wausau Tile Inc.
- B. Comply with ASTM C 858 for design and manufacturing processes.
- C. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
1. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.
 - a. Cover Hinges: Concealed, with hold-open ratchet assembly.
 - b. Cover Handle: Recessed.
 2. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 3. Cover Legend: Molded lettering, "ELECTRIC."
 4. Configuration: Units shall be designed for flush burial and have integral closed bottom unless otherwise indicated.
 5. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.

- a. Extension shall provide increased depth of 12 inches (300 mm)
 - b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
6. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.
7. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks, plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.
 - a. Windows shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
 - b. Window opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
 - c. Window openings shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
8. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.5 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. General Requirements for Handholes and Boxes: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
 1. Color: Gray.
 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, "ELECTRIC"
 6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
 7. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.
- B. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Armorcast Products Company.
 - b. Carson Industries LLC.
 - c. NewBasis.
 - d. Quazite: Hubbell Power Systems, Inc.

2.6 PRECAST MANHOLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carder Concrete Products.
 - 2. Christy Concrete Products.
 - 3. Elmhurst-Chicago Stone Co.
 - 4. Oldcastle Precast Group.
 - 5. Riverton Concrete Products; a division of Cretex Companies, Inc.
 - 6. Utility Concrete Products, LLC.
 - 7. Utility Vault Co.
 - 8. Wausau Tile, Inc.
- B. Comply with ASTM C 858 and with interlocking mating sections, complete with accessories, hardware, and features.
 - 1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
 - a. Windows shall be located no less than 6 inches from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
 - b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
 - c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.
- C. Concrete Knockout Panels: 1-1/2 to 2 inches thick, for future conduit entrance and sleeve for ground rod.
- D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.7 CAST-IN-PLACE MANHOLES

- A. Description: Underground utility structures, constructed in place, complete with accessories, hardware, and features. Include concrete knockout panels for conduit entrance and sleeve for ground rod.
- B. Materials: Comply with ASTM C 858 and with Division 03 Section "Cast-in-Place Concrete."
- C. Structural Design Loading: As specified in Part 3 "Underground Enclosure Application" Article.

2.8 UTILITY STRUCTURE ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bilco Company (The).
 - 2. Campbell Foundry Company.
 - 3. Carder Concrete Products.
 - 4. Christy Concrete Products.
 - 5. East Jordan Iron Works, Inc.

TRAUTMAN ASSOCIATES
11580 WALDEN AVE LLC
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TA PROJECT #24003

6. Elmhurst-Chicago Stone Co.
7. McKinley Iron Works, Inc.
8. Neenah Foundry.
9. NewBasis.
10. Oldcastle Precast, Inc.
11. Osburn Associates, Inc.
12. Pennsylvania Insert Corporation.
13. Quazite: Hubbell Power Systems, Inc.
14. Rinker Group, Ltd.
15. Riverton Concrete Products.
16. Underground Devices, Inc.
17. Utility Concrete Products, LLC.
18. Utility Vault Co.
19. Wausau Tile Inc.

- B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.
1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 26 inches
 - a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
 2. Cover Legend: Cast in. Selected to suit system.
 - a. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.
 - b. Legend: "SIGNAL" for communications, data, and telephone duct systems.
 3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
 - a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C 387, Type M, may be used.
- C. Manhole Sump: depression in floor 12-inch (300-mm-) diameter, 4-inch- (100-mm-) deep
- D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch-diameter eye, and 1-by-4-inch bolt.
1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.
- E. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch-diameter eye, rated 2500-lbf minimum tension.
- F. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch-diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.
1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.

- G. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.
 - 1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.
- H. Ground Rod Sleeve: 3-inch (75-mm), PVC conduit sleeve in manhole floors 2 inches (50 mm) from the wall adjacent to, but not underneath, the ducts routed from the facility.
- I. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch (13-mm) bolt, 5300-lbf (24-kN) rated pullout strength, and minimum 6800-lbf (30-kN) rated shear strength..
- J. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.
 - 1. Stanchions: Nominal 36 inches high by 4 inches wide, with minimum of 9 holes for arm attachment.
 - 2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from 3 inches with 450-lb minimum capacity to 20 inches with 250-lb minimum capacity. Top of arm shall be nominally 4 inches wide, and arm shall have slots along full length for cable ties.
- K. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C). Capable of withstanding temperature of 300 deg F (150 deg C) without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.
- L. Portable Manhole Ladders: UL-listed, heavy-duty fiberglass specifically designed for portable use for access to electrical manholes. Minimum length equal to distance from deepest manhole floor to grade plus 36 inches. One required
- M. Cover Hooks: Heavy duty, designed for lifts 60 lbf (270 N) and greater. Two required.

2.9 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C 1037.
- B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.
- C. Clear and grub vegetation to be removed, and protect vegetation to remain according to Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication according to Section 311000 "Site Clearing."

3.2 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Cables Over 600 V: RNC, NEMA Type EPC-40 PVC, in concrete-encased duct bank, unless otherwise indicated.
- B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank unless otherwise indicated.
- C. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-80-PVC, in direct-buried duct bank where indicated.
- D. Underground Ducts Crossing Paved Paths, Walks, and Parking Driveways: RNC, NEMA Type EPC-40-PVC, encased in reinforced concrete.

3.3 UNDERGROUND ENCLOSURE APPLICATION

- A. Manholes: Precast or cast-in-place concrete.
 - 1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
 - 2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.
- B. Handholes and Boxes for 600 V and Less:
 - 1. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20, Polymer concrete, SCTE 77, Tier 15 structural load rating.
 - 2. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10, Polymer concrete units, SCTE 77, Tier 8 structural load rating.
 - 3. Cover design load shall not exceed the design load of the handhole or box.

3.4 EARTHWORK

- A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses".
- D. Cut and patch existing pavement in the path of underground ducts and utility structures according to the "Cutting and Patching" Article in Section 017300 "Execution."

3.5 DUCT INSTALLATION

- A. Install ducts according to NEMA TCB 2.
- B. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes, to drain in both directions.
- C. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 12.5 feet (4 m) horizontally at other locations unless otherwise indicated.
- D. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.
- E. Duct Entrances to Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
 - 2. Grout end bells into structure walls from both sides to provide watertight entrances.
- F. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet (3 m) outside the building wall, without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- G. Sealing: Provide temporary closure at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.
- H. Pulling Cord: Install 100-lbf- (445-N-) test nylon cord in empty ducts.
- I. Concrete-Encased Ducts: Support ducts on duct separators.

1. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes less than 6 inches (150 mm) in nominal diameter.
2. Width: Excavate trench 12 inches (300 mm) wider than duct bank on each side when using forms.
3. Width: Excavate trench 3 inches (75 mm) wider than duct bank on each side, if no forms are used.
4. Depth: Install top of duct bank at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
5. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
6. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than five spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent floating during concreting. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
7. Minimum Space between Ducts: 3 inches (75 mm) between ducts and exterior envelope wall, 2 inches (50 mm) between ducts for like services, and 4 inches (100 mm) between power and signal ducts.
8. Elbows: Use manufactured duct elbows for stub-ups at poles and equipment, at building entrances through floor, and at changes of direction in duct run unless otherwise indicated. Extend concrete encasement throughout length of elbow.
9. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
10. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
11. Concrete Cover: Install a minimum of 3 inches (75 mm) of concrete cover at top and bottom, and a minimum of 2 inches (50 mm) on each side of duct bank.
12. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch (15-mm) reinforcing-rod dowels extending a minimum of 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.
13. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.

J. Direct-Buried Duct Banks:

1. Excavate trench bottom to provide firm and uniform support for duct bank. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for pipes less than 6 inches (150 mm) in nominal diameter.
2. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.

3. Space separators close enough to prevent sagging and deforming of ducts, with not less than five spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches (150 mm) between tiers.
4. Depth: Install top of duct bank at least 36 inches (900 mm) below finished grade unless otherwise indicated.
5. Set elevation of bottom of duct bank below frost line.
6. Install ducts with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and signal ducts.
7. Elbows: Install manufactured duct elbows for stub-ups at building entrances through floor, and at changes of direction in duct run unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
8. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.
 - a. Place minimum 3 inches (75 mm) of sand as a bed for duct bank. Place sand to a minimum of 6 inches (150 mm) above top level of duct bank.
 - b. Place minimum 6 inches (150 mm) of engineered fill above concrete encasement of duct bank.

- K. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

3.6 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Cast-in-Place Manhole Installation:

1. Finish interior surfaces with a smooth-troweled finish.
2. Windows for Future Duct Connections: Form and pour concrete knockout panels 1-1/2 to 2 inches thick, arranged as indicated.
3. Cast-in-place concrete, formwork, and reinforcement are specified in Division 03 Section "Cast-in-Place Concrete".

B. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891 unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevations:

1. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
 2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.
 3. Install handholes with bottom below the frost line, 48" below grade.
 4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
 5. Where indicated, cast handhole cover frame integrally with handhole structure.
- D. Drainage: Install drains in bottom of manholes where indicated.
- E. Manhole Access: Circular opening in manhole roof; sized to match cover size.
1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
- F. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney
- G. Dampproofing: Apply dampproofing to exterior surfaces of manholes and handholes after concrete has cured at least three days. After ducts are connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.
- H. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, as required for installation and support of cables and conductors and as indicated.
- I. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches (97 mm) for manholes and 2 inches (50 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.
- J. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.
- 3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE
- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by manufacturer.
 - B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
 - C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
 - D. Install handholes and boxes with bottom below frost line, min 36" below grade.
 - E. Field cut openings for ducts and 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.

- F. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth
 - 1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Section 033000 "Cast-in-Place Concrete," with a troweled finish.
 - 2. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep)]

3.8 GROUNDING

- A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
 - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 6-inch- (150-mm-) long mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
 - 3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.10 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump. Remove foreign material.

END OF SECTION 260543

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Labels.
2. Bands and tubes.
3. Tapes and stencils.
4. Tags.
5. Signs.
6. Cable ties.
7. Miscellaneous identification products.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Labels.
2. Bands and tubes.
3. Tapes and stencils.
4. Tags.
5. Signs.
6. Cable ties.
7. Miscellaneous identification products.

B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1.

B. Comply with 29 CFR 1910.144 for color identification of hazards; 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs and tags; and the following:

1. Fire-protection and fire-alarm equipment must be finished, painted, or suitably marked safety red.
 2. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than 7.7 ft above finished floor.
- C. Signs, labels, and tags required for personnel safety must comply with the following standards:
1. Safety Colors: NEMA Z535.1.
 2. Facility Safety Signs: NEMA Z535.2.
 3. Safety Symbols: NEMA Z535.3.
 4. Product Safety Signs and Labels: NEMA Z535.4.
 5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.
- D. Comply with Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 1000 V or Less:
1. Black letters on orange field.
 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded service and feeder conductors.
1. Color must be factory applied.
 2. Colors for 208Y/120 V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 3. Colors for 240 V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 4. Colors for 480Y/277 V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 5. Color for Neutral: White or gray.
 6. Color for Equipment Grounds: Green.

C. Warning Label Colors:

1. Identify system voltage with black letters on orange background.

D. Warning labels and signs must 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 3 FEET MINIMUM."

E. Equipment Identification Labels:

1. Black letters on white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

C. Self-Adhesive Wraparound Labels: Preprinted, 3 mil thick, vinyl flexible label with acrylic pressure-sensitive adhesive.

1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over legend. Labels sized such that clear shield overlaps entire printed legend.
2. Marker for Labels:
 - a. Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Polyester, thermal, transfer-printed, 3 mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Minimum Nominal Size:
 - a. 1-1/2 by 6 inch for raceway and conductors.
 - b. 3-1/2 by 5 inch for equipment.

2.4 BANDS AND TUBES

A. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inch long, with diameters sized to suit diameters and that stay in place by gripping action.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at maximum of 200 deg F. Comply with UL 224.

2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mil thick by 1 to 2 inch wide; compounded for outdoor use.
- C. Tape and Stencil: 4 inch wide black stripes on 10 inch centers placed diagonally over orange background and are 12 inch wide. Stop stripes at legends.
- D. Floor Marking Tape: 2 inch wide, 5 mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
- E. Underground-Line Warning Tape:
 - 1. Tape:
 - a. Recommended by manufacturer for method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape must be permanent and may not be damaged by burial operations.
 - c. Tape material and ink must be chemically inert and not be subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - 2. Color and Printing:
 - a. Comply with APWA Uniform Color Code using NEMA Z535.1 safety colors.
 - b. Inscriptions for Red Tapes: "CAUTION BURIED ELECTRIC LINE BELOW".
 - c. Inscriptions for Orange Tapes: "CAUTION BURIED COMMUNICATION LINE BELOW".
 - 3. Detectable Tape:
 - a. Reinforced, detectable three-layer laminate, consisting of printed pigmented woven scrim, solid aluminum-foil core, and clear protective film that allows inspection of continuity of conductive core; bright-colored, continuous-printed on one side with inscription of utility, compounded for direct-burial service.
 - b. Width: 3 inch.
 - c. Overall Thickness: 8 mil.
 - d. Foil Core Thickness: 0.35 mil.
 - e. Weight: 34 lb/1000 sq. ft.
 - f. Tensile in accordance with ASTM D882: 300 lbf and 12,500 psi.
- F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height must be 1 inch.

2.6 TAGS

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.
- C. Write-on Tags:
 - 1. Polyester Tags: 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment.
 - 2. Marker for Tags:
 - a. Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - b. Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 SIGNS

- A. Baked-Enamel Signs:
 - 1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
 - 2. 1/4 inch grommets in corners for mounting.
 - 3. Nominal Size: 7 by 10 inch.
- B. Metal-Backed Butyrate Signs:
 - 1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396 inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
 - 2. 1/4 inch grommets in corners for mounting.
 - 3. Nominal Size: 10 by 14 inch.
- C. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Engraved legend.
 - 2. Thickness:
 - a. For signs up to 20 sq. inch, minimum 1/16 inch thick.
 - b. For signs larger than 20 sq. inch, 1/8 inch thick.
 - c. Engraved legend with white letters on dark gray background.
 - d. Self-adhesive.
 - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F in accordance with ASTM D638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black, except where used for color-coding.
- B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F in accordance with ASTM D638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black.
- C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 deg F in accordance with ASTM D638: 7000 psi.
 - 3. UL 94 Flame Rating: 94V-0.
 - 4. Temperature Range: Minus 50 to plus 284 deg F.
 - 5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. 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 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 1000 V: Identification must completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- I. Emergency Operating Instruction Signs: Install instruction signs with white legend on red background with minimum 3/8 inch high letters for emergency instructions at equipment used for power transfer and load shedding.
- J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from floor.
- K. Accessible Fittings for Raceways: Identify cover of junction and pull box of the following systems with wiring system legend and system voltage. System legends must be as follows:
 - 1. "EMERGENCY POWER."
 - 2. "POWER."
 - 3. "UPS."
- L. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to location and substrate.
- M. Snap-Around Labels: Secure tight to surface at location with high visibility and accessibility.

- N. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.
- O. Self-Adhesive Labels:
 - 1. Install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high label; where two lines of text are required, use labels 2 inch high.
- P. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.
- Q. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.
- R. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.
- S. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of 6 inch where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- T. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- U. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's instructions.
- V. Underground Line Warning Tape:
 - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inch below finished grade. Use multiple tapes where width of multiple lines installed in common trench or concrete envelope exceeds 16 inch overall.
 - 2. Install underground-line warning tape for direct-buried cables and cables in raceways.
- W. Metal Tags:
 - 1. Place in location with high visibility and accessibility.
 - 2. Secure using cable ties.
- X. Nonmetallic Preprinted Tags:
 - 1. Place in location with high visibility and accessibility.
 - 2. Secure using cable ties.
- Y. Write-on Tags:

1. Place in location with high visibility and accessibility.
2. Secure using cable ties.

Z. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on minimum 1-1/2 inch high sign; where two lines of text are required, use signs minimum 2 inch high.

AA. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high sign; where two lines of text are required, use labels 2 inch high.

BB. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
2. Unless otherwise indicated, provide single line of text with 1/2 inch high letters on 1-1/2 inch high sign; where two lines of text are required, use labels 2 inch high.

CC. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways and Metal-Clad Cables, 1000 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50 ft maximum intervals in straight runs, and at 25 ft maximum intervals in congested areas.
- D. Accessible Fittings for Raceways and Cables within Buildings: Identify cover of junction and pull box of the following systems with self-adhesive labels containing wiring system legend and system voltage. System legends must be as follows:

1. "EMERGENCY POWER."
 2. "POWER."
 3. "UPS."
- E. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with conductor designation.
- F. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- G. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in direction of access to live parts. Workspace must comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- H. Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.
- I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
1. Apply to exterior of door, cover, or other access.
 2. For 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.
- J. Arc Flash Warning Labeling: Self-adhesive labels.
- K. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.
- L. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on red background with minimum 3/8 inch high letters for emergency instructions at equipment used for power transfer and load shedding.
- M. Equipment Identification Labels:
1. Indoor Equipment: Baked-enamel signs.
 2. Outdoor Equipment: Laminated acrylic or melamine sign] [Stenciled legend 4 inch high.
 3. Equipment to Be Labeled:
 - a. Panelboards: Panelboard identification must be in form of self-adhesive, engraved laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchgear.
 - e. Switchboards.
 - f. Transformers: Label that includes tag designation indicated on Drawings for transformer, feeder, and panelboards or equipment supplied by secondary.

- g. Substations.
- h. Emergency system boxes and enclosures.
- i. Motor-control centers.
- j. Enclosed switches.
- k. Enclosed circuit breakers.
- l. Enclosed controllers.
- m. Variable-speed controllers.
- n. Push-button stations.
- o. Power-transfer equipment.
- p. Contactors.
- q. Remote-controlled switches, dimmer modules, and control devices.
- r. Battery-inverter units.
- s. Battery racks.
- t. Power-generating units.
- u. Monitoring and control equipment.
- v. UPS equipment.

END OF SECTION 260553

SECTION 311000 - SITE CLEARING

1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes the following:
 - 1. Protection of existing trees.
 - 2. Removal of trees and other vegetation.
 - 3. Topsoil stripping.
 - 4. Clearing and grubbing.
 - 5. Removing above-grade improvements.
 - 6. Removing below-grade improvements.

1.03 PROJECT CONDITIONS

- A. Traffic: Conduct site clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction.
- B. Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place.
 - 1. Protect improvements on adjoining properties and on Owner's property.
 - 2. Restore damaged improvements to their original condition, as acceptable to property owners.
- C. Protection of Existing Trees and Vegetation: Protect existing trees and other vegetation indicated to remain in place, against unnecessary cutting, breaking or skinning of roots, skinning or bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.
 - 1. Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction operations.

2. Provide protection for roots over 1-1/2 inch diameter that are cut during construction operations. Coat cut faces with an emulsified asphalt, or other acceptable coating, formulated for use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.
 3. Repair or replace trees and vegetation indicated to remain, which are damaged by construction operations, in a manner acceptable to Architect. Employ a licensed arborist to repair damages to trees and shrubs.
 4. Replace trees, which cannot be repaired and restored to full-growth status, as determined by arborist.
- D. Improvements on Adjoining Property: Authority for performing removal and alteration work on property adjoining Owner's property will be obtained by Owner prior to award of contract.
1. Extent of work on adjacent property is indicated on Drawings.

2 – PRODUCTS (Not Applicable)

3 - EXECUTION

3.01 SITE CLEARING

- A. General: Remove trees, shrubs, grass and other vegetation, improvements, or obstructions as required to permit installation of new construction. Remove similar items elsewhere on site or premises as specifically indicated. "Removal" includes digging out and off-site disposing of stumps and roots.
2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner, where such roots and branches obstruct installation of new construction.
- B. Topsoil: Topsoil is defined as friable clay loam surface soil found in a depth of not less than 4 inches. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over 2 inches in diameter, and without weeds, roots, and other objectionable material.
1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material.
 - a. Remove heavy growths of grass from areas before stripping.
 - b. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines to prevent damage to root system.
 3. Dispose of unsuitable or excess topsoil same as specified for disposal of waste material.

- C. Clearing and Grubbing: Clear site of trees, shrubs and other vegetation, except for those indicated to be left standing.
 - 1. Completely remove stumps, roots, and other debris protruding through ground surface.
 - 2. Use only hand methods for grubbing inside drip line of trees indicated to remain.
 - 3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
 - a. Place fill material in horizontal layers not exceeding 6 inches loose depth, and thoroughly compact to a density equal to adjacent original ground.
- D. Removal of Improvements: Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction.
 - 1. Abandonment or removal of certain underground pipe or conduits may be indicated on mechanical or electrical drawings, and is included under work of related Division 15 and 16 sections. Removal of abandoned underground piping or conduit interfering with construction is included under this Section.

3.02 DISPOSAL OF WASTE MATERIALS

- A. Burning on Owner's Property: Burning is not permitted on Owner's property.
- B. Removal from Owner's Property: Remove waste materials and unsuitable or excess topsoil from Owner's property.

END OF SECTION 311000

SECTION 312000 - EARTHWORK

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

Furnish all labor, material and equipment necessary to complete all site earthwork, as shown and specified, including but not limited to the following:

1. Excavation, filling, grading and subgrade preparation for building slabs, walks and pavements.
2. Excavation, trenching and backfilling for all structures, foundations, exterior and interior utilities and other improvements.
3. Disposal of all excess and waste materials (including oil contaminated soils).

B. Related Work Specified Elsewhere:

1. Subsurface Data Logs - See Bidding Requirements.
2. Testing Laboratory Services - See Section 014100.
3. Site Clearing and Preparation - See Section 311000.
4. Excavation and Rough Grade Backfill for Mechanical Work
5. Excavation and Rough Grade Backfill for Electrical Work

1.02 REQUIREMENTS FOR REGULATORY AGENCIES

- A. State and Federal Code requirements shall control the disposal of waste materials and contaminated soils, if encountered.

1.03 STANDARDS

- A. Comply with the State Department of Transportation Standards except as otherwise specified herein.
- B. Comply with State and Local Environmental Standards as specified herein.

1.04 COOPERATION

- A. Examine Drawings and specifications for all Contracts, to determine nature of proposed construction. Perform work to conform with construction called for in such a manner as not to interfere or delay work of other Contractors.

1.05 JOB CONDITIONS

- A. A Geotechnical Report has been prepared by the Owner's Geotechnical Engineer and is available, upon request, from the Owner. The approximate character of the encountered subsoils and depths of various strata, as disclosed by the borings, are shown on the enclosed boring logs. This data is included as general information only and the Owner does not guarantee that conditions differing greatly from those disclosed by the borings will not be encountered at other points on the site.
- B. The exact quantity, size, location and elevation of existing below grade obstructions to be demolished and removed are unknown. The information provided on the Contract Documents is approximate and is to be used only as a guide during the bidding phase and demolition operations. The Owner/Architect assumes no responsibility for the accuracy or completeness of the Geotechnical Investigation. If actual below grade conditions vary from information shown on the Contract Documents, notify the Architect or Owner's field representative immediately for additional information or direction. Continue with excavation only after receiving a written notice to proceed.
- C. Should uncharted or incorrectly charted below grade obstructions, rubble, existing building foundations, fill, or deleterious (organic) materials be encountered during excavation, notify the Architect or Owner's field representative immediately for additional information or direction.

1.06 EXISTING UTILITIES

- A. Locate existing underground utilities in the area of work.
- B. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult the Owner's Representative immediately for direction.
- C. Do not interrupt existing utilities serving facilities occupied or used by the Owner or others except when a temporary utility plan is provided by the Architect.
- D. Provide adequate protection for aerial or underground utility lines noted to remain.
- E. Demolish and dispose of existing underground utilities indicated to be removed and plug open ends with concrete. Coordinate with utility owners for shut-off of services if lines are active.
- F. Repair damaged utility lines to the satisfaction of the utility owner.

1.07 PROTECTION

- A. Protect the excavation and/or exposed building walls and foundations from frost and freezing until concrete work can be performed.
- B. Protect existing structures and site features noted to remain against damage during all sequences of construction.

- C. Barricade open excavations occurring as part of this work and post with warning lights. Operate warning lights for hours from dusk to dawn each day and as otherwise required.
- D. In case of any damage or injury caused in the performance of this work, the Contractor shall, at his own expense, make good such damage or injury to the satisfaction of the Owner. Existing roads, walks, curbs and buildings damaged during project work shall be repaired or replaced to their original condition at the commencement of operations.

1.08 INSPECTION, TESTING AND QUALITY CONTROL

- A. A Soils Testing Agency will be employed by the Owner for quality control, testing and inspection of work and materials during earthwork operations.
- B. The service of this testing agency is intended for the Owner's verification and shall in no way relieve the Contractor of his responsibility to follow the requirements of the Contract Documents and to provide his own inspection and quality control.
- C. The following minimum tests shall be made. ASTM Designations specified refer to the latest publication.
 - 1. Existing Subgrades
 - a. Field verification of proofrolled subgrades.
 - 2. Borrow Materials
 - a. Particle Size Analysis, ASTM C-117.
 - b. Maximum Density and Optimum Moisture Content, ASTM D-1557 or Relative Density, ASTM D-4253 or ASTM D-4254.
 - c. Plasticity Index, ASTM D-4318.
 - d. Frost Susceptibility Analysis.
 - 3. Compacted Fill Materials
 - a. In Place Density, ASTM D-1556 (sand cone) or ASTM D-2922 (nuclear).
 - b. Moisture Content, ASTM D-2216.
 - c. Verification of all natural soil, structural fill or rock foundation subgrades for a design bearing pressure of 3000 pounds per square foot.
- D. All tests on borrow materials shall be performed before acceptance and delivery of fill to the site. Any change in the source of material or change in quality of the material will require a new series of tests to determine acceptability.

- E. Delivery and compaction of fill material shall be made during the presence of the Soils Testing Agency and shall be subject to their approval. This inspection by no means absolves the Contractor from responsibility of compaction as specified.
- F. Acceptance and rejection of fill placed in accordance with 95%, and 90% (as specified) of maximum density attainable by the Modified Proctor Method of Compaction (ASTM D-1557) shall be based upon the following in place density test result requirements for each lift, and all other requirements as stated in the Specifications.
 - 1. Requirements for 95% of Maximum Density (ASTM D-1557). The results of all in place density tests must meet the following requirements.
 - a. The average of any three consecutive tests shall be equal to, or greater than, 95% of the maximum density.
 - b. No more than one in four consecutive tests shall be less than 95% of the maximum density.
 - c. No test result shall be less than 94.0% of the maximum density.
 - 2. Requirements for 90% of the Maximum Density (ASTM D-1557). The results of all in place density tests must be greater than or equal to 90% of the maximum density.
- G. An alternative appropriate density test procedure shall be determined by the Soils Testing Agency to obtain the maximum density where material gradations do not permit use of ASTM D-1557 to determine the maximum density requirement will be based.
- H. All earthwork shall be performed by personnel experienced in these operations. It is the responsibility of the Contractor to provide such personnel.

1.09 SUBMITTALS

- A. Test Reports - Soils Testing Agency:

Submit reports for all earthwork inspections and tests. Furnish copies directly to the Architect, the Contractor, and any others as indicated.
- B. Submit evidence to the Architect/Engineer that the borrow material supplier is certified to produce fill material which conforms to the New York State Department of Transportation (NYSDOT).

PART 2 - PRODUCTS

2.01 MATERIALS

- A. General Fill:
 - 1. Satisfactory soil materials including sand, gravel, friable earth or clays of low

plasticity, free of organic materials, frozen material, trash, masonry, rubble, concrete, debris and free of stones having a dimension of 4-inches or greater.

B. Concrete Sand:

1. Comply with NYSDOT Item 703-07. Slag not permitted.
2. Clean, sharp, well-graded, free from clay, free draining sand with the following gradation requirements:

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8"	100
No. 4	90 - 100
No. 8	75 - 100
No. 16	50 - 85
No. 30	25 - 60
No. 50	10 - 30
No. 100	1 - 10
No. 200	0 - 3

C. Gravel:

1. Comply with NYSDOT Item 703-02, Type 1. Slag not permitted.
2. Clean, hard, sound, durable, uniform in quality, and free from any organic or deleterious materials, with the following gradation requirements:

<u>Sieve Size</u>	<u>Percent Passing</u>
1"	100
1/2"	90 - 100
1/4"	0 - 15

D. Structural Fill:

1. Comply with NYSDOT Item 304-2.02, Type 2 or Type 4. Slag not permitted.
2. Clean, hard, sound, durable, uniform in quality, and free from any organic or deleterious materials, with the following gradation requirements:

<u>Sieve Size</u>	<u>Percent Passing</u>
2"	100
1/4"	25 - 60
No. 40	5 - 40
No. 200	0 - 10

E. Crushed Stone:

1. Comply with NYSDOT 703-02.
2. Crushed stone or washed crushed gravel, hard, sound, durable, uniform in quality and free of any detrimental quantity of soft, friable, thin, elongated or laminated pieces, disintegrated material, organic matter, oil alkali or deleterious substances.

<u>Sieve Size</u>	<u>Percent Passing</u>
1-1/2"	100
1"	90 - 100
1/2"	25 - 60
No. 4	0 - 10
No. 8	0 - 5

F. Non-Frost Susceptible Material:

1. Well graded granular material with a maximum diameter of 2-inches and with less than 5% passing a No. 200 sieve.

G. Woven Geotextile Fabric:

1. Subject to compliance with project requirements, provide one (1) of the following:
 - a. Terratex GS
 - b. Exxon GTF 200
 - c. Mirafi 600X
 - d. Amoco 2002

H. Non-Woven Geotextile Fabric:

1. Subject to compliance with project requirements, provide one (1) of the following:
 - a. Terratex SD
 - b. Exxon GTF 130D
 - c. Mirafi 140N
 - d. Amoco 4545

I. Topsoil:

1. Furnish all topsoil required to complete the project.
2. Topsoil shall be natural, fertile, friable granular soil characteristic of productive soils in the vicinity, uniform in composition and texture, free from subsoil, clay lumps, stones, organic material, toxic or hazardous substances, and any material two inches or more in greatest dimension.

PART 3 - EXECUTION

3.01 GENERAL

- A. Excavate for proper placing of required work to elevations and dimensions indicated, plus sufficient space to permit erection of forms, shoring, drain tile, and the inspection of foundations. Contact pertinent utility company before excavating near underground lines.
- B. Excavated materials are assumed to be earth and other materials that can be removed with power shovel, except where rock is indicated.
- C. Rock is defined as any material which cannot be dislodged and excavated with modern track-mounted heavy-duty excavating equipment equipped with a 2-3/8 cubic yard bucket and appropriately sized "Ho-Ram" and without drilling, blasting or ripping. Typical of materials classified as rock are boulders 1/2 cubic yard or more in volume, and solid cementitious aggregate deposits.
- D. Do not perform rock excavation work until material to be excavated has been cross-sectioned and classified by the Soils Testing Agency. Such excavation will be paid on basis of unit prices as listed in the Bid Form.
- E. Rock payment lines are limited to the following:
 - 1. Two feet outside of concrete work for which forms are required, except footings.
 - 2. One foot outside the perimeter and 4" below the bottom of footings.
 - 3. In pipe trenches, 6" below invert elevation (or as indicated) of pipe and 2 feet wider than the indicated width but not less than 3 feet minimum trench width.
 - 4. Outside dimensions of concrete work where no forms are required.
 - 5. Under slabs on grade, 6" below bottom of concrete slab.
- F. The cost of any indicated rock removal shall be included in the base bid. For any additional rock removal required, but not indicated, the Contract will be adjusted by change order in accordance with unit prices submitted, or by negotiations as directed. Additional rock removal will be paid for on the line of the foundation or utility trenches as indicated on the Contract Drawings.
- G. Use of explosives:

The use of explosives is not permitted.
- H. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of the Architect or the Soils Testing Agency. Unauthorized excavation, as well as remedial work directed by the Architect or Soils Testing Agency, shall be at the Contractors expense.

- I. Unauthorized excavations below foundations and grade beams may be brought to proper position using lean concrete or approved compacted fill material.

3.02 STABILITY OF EXCAVATIONS

- A. Slope sides of excavations are to comply with the local codes, ordinances and requirements of agencies having jurisdiction. Shore and/or brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
- B. Provide materials for shoring and bracing, such as sheet piling, up-rights, stringers, and cross braces, as required. Maintain shoring and bracing in excavations regardless of time period excavations will remain open. Extend shoring and bracing as excavation progresses.

3.03 DEWATERING

- A. Prevent surface water and subsurface ground water from flowing into excavations and from flooding project site and surrounding area.
- B. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.
- C. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to collecting or runoff areas. Do not use trench excavations as temporary drainage ditches.

3.04 EXCAVATION FOR BUILDING FOUNDATIONS AND SLABS ON GRADE

- A. Within the limits of the proposed building, remove existing surface soil material, including vegetation, topsoil and loose boulders to a minimum depth of 12 inches below existing surface grade or 12 inches below the underside of concrete slab on grade construction.
- B. Prior to the start of excavation for foundations or filling for the slab on grade subbase, the exposed surface soil must be proofrolled, with a minimum 10-ton static roller, in the presence of the Soils Testing Agency. Where uncontrolled fill, soft, loose or yielded material exists, these areas must be undercut a minimum of 2'-0". Testing and inspection of the undercut subgrade, by the Soils Testing Agency, may require further undercutting on some areas, depending on the type and nature of fill/unsuitable material exposed.
- C. Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10', and extend a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.

- D. Take care in excavating not to disturb bottom of excavation. Excavate by hand, if necessary, to final grade just before concrete reinforcement is placed. Trim bottoms to required lines and grades to leave solid base to receive other work.
- E. Excavation for below grade floor levels may proceed by conventional means to approximately 2 feet above final excavated subgrade level for slab on grade construction. Further excavation to the subgrade level must be accomplished by methods which minimize traffic on the subgrade, such as backhoe or gradual methods.
- F. Excavation for foundations must proceed, as a minimum, to the limits shown on the drawings. All foundations shall bear on compacted undisturbed natural soil or structural fill, as per the Geotechnical Recommendations Report. Any wet, soft, or unsuitable materials shall be undercut until the soil stabilizes or in accordance with the details shown on the drawings. Replace any undercut areas with approved compacted fill.
- G. The subgrade surface of all foundations and slabs on grade shall be level and clean, free of loose rock, dirt, debris, standing water, frost or ice, prior to acceptance for casting concrete.

3.05 EXCAVATION FOR PAVED AREAS

- A. Excavate below paved areas to comply with cross-sections, elevations, and grades as indicated.
- B. Where uncontrolled fill, soft, loose or yielded material exists, these areas must be undercut a minimum of 2'-0". Further undercut any areas which do not stabilize and replace with approved compacted fill.

3.06 EXCAVATION FOR TRENCHES

- A. Excavate trenches to the uniform width required for particular item to be installed, sufficiently wide to provide ample working room. Provide 1'-0" minimum clearance on both sides of pipe or conduit, but not less than 3'-0" total trench width.
- B. Excavate trenches to depth indicated or required. Carry depth of trenches for piping to establish indicated flow lines and invert elevations.
- C. Where rock is encountered, carry excavations 6" below required elevation and backfill with a layer of crushed stone or gravel prior to installation of pipe.
- D. Grade bottoms of trenches as indicated, notching to provide solid bearing for entire body of pipe.
- E. Do not backfill trenches until tests and inspections have been made and backfilling authorized by the Architect/Engineer. Use care in backfilling to avoid damage or displacement of pipe systems.

3.07 DISPOSAL OF UNSUITABLE AND EXCESS EXCAVATED MATERIAL

- A. Remove from site and dispose of excavated material unsuitable for fill and/or backfill.
- B. Place excess excavated materials, suitable for fill and/or backfill, on site where directed.
- C. Remove from site and dispose of any excess excavated materials after all fill and backfill operations have been completed.

3.08 COMPACTION EQUIPMENT

- A. It is the responsibility of the Contractor to select, furnish, and properly maintain equipment, which will compact the subgrade and fill uniformly to the required density.
- B. The Contractor shall have at the site, at all times during earthwork operations, a smooth steel wheel roller, with a rated capacity of at least 10 tons, which shall be used to seal the surface of the fill at the close of each working day to prevent infiltration of precipitation and surface water into the fill material.
- C. Excavation to final subgrade shall not proceed and fill shall not be placed until approved compaction equipment is on the site and in working condition.

3.09 PROTECTION OF SUBGRADES

- A. Contractors will take every precaution during final stages of excavation to prevent disturbance of the natural soil at proposed subgrade elevations. Such precautions shall include, but not be limited to, keeping equipment off final subgrade during the last several feet of excavation, using excavating buckets without teeth, placing concrete mud mats below foundations and dewatering excavations.
- B. Additional excavations, undercutting and/or backfilling operations resulting from failure to properly protect approved subgrades shall be done at the expense of the Contractor.

3.10 GEOTEXTILE FABRIC INSTALLATION

- A. All subgrades must be tested and approved by the Soils Testing Agency before installation of geotextile fabric.
- B. Above the prepared subgrade surface place a geotextile separation and strength fabric and a minimum 12-inch thick select granular base cover.

3.11 FILLING AND BACKFILLING

- A. Preparation:
 - 1. All subgrades must be tested and approved by the Soils Testing Agency before placing fill and/or backfill. Do not backfill against foundation walls until tested and approved by the Soils Testing Agency.
 - 2. Remove all debris from excavations before placing fill and/or backfill.

B. Use of Materials:

1. General Fill

- a. Fill and backfill exterior side of site structures to subgrade where no slab on grade, no pavement, and no foundation drains occur.
- b. Site fill where no pavement occurs.
- c. Fill and backfill to subgrade at site trenches where no slab on grade or pavement occurs.
- d. Fill and backfill to subgrade where demolition is required and no building or pavement occurs. In addition to earth fill, block, brick, stone and concrete not exceeding 1 cu. ft. per unit may be used if kept a minimum of 12" below finished subgrade.
- e. Fill and backfill in areas not specified on drawings.

2. Concrete Sand

- a. Backfill as required and detailed for underground tanks.
- b. Bedding as detailed for mechanical and electrical utility trenches.
- c. Backfill above foundation drains as detailed on plan.

3. Gravel

- a. Porous subbase material for slab on grade construction and pavement.
- b. Backfill at site trenches where pavement occurs.

4. Structural Fill

- a. Fill and backfill beneath foundations (minimum of 6" required) or substitution of a lean concrete "mud" mat as approved by the Architect/Engineer.
- b. Fill and backfill building walls and site structures to subgrade where no footing drains occur. Material to extend 24" beyond edge of asphalt pavement and 6" beyond edge of concrete pavement.
- c. Fill and backfill beneath porous subbase material specified for slab on grade construction and pavement.
- d. Porous subbase material, if demonstrated porous, for slab on grade construction and pavement.

- e. Select backfill at site trenches where pavement occurs.
 - 5. Crushed Stone
 - a. Surround foundation pipe with filter material, minimum 12" around pipe, wrapped with soil separator, minimum 12" overlap at top.
 - 6. Non-frost susceptible material
 - a. As required on structural drawings.
 - 7. The Contractor may propose alternate materials with similar engineering properties for consideration by Architect/Engineer. Such materials shall be proposed only where substitution results in a credit to the Owner.
- C. Placement of Fill Materials:
- 1. Backfill excavations and place fill after areas have been tested and approved by Soils Testing Agency.
 - 2. Do not place any fill material when the fill, the previous lift of fill, or the subgrade on which it is to be placed is frozen. In the event that any fill which has been placed or the subgrade becomes frozen, it shall be scarified, as required to break up the frozen material, and recompacted or removed to the satisfaction of the Soils Testing Agency. Any soft areas resulting from frost shall be recompacted or removed to the satisfaction of the Soils Testing Agency.
 - 3. Open areas - The fill shall be spread evenly by mechanical or manual means, in approximately horizontal layers of six (6) to eight (8) inches maximum loose thickness.
 - 4. Limited access - Where large compaction equipment cannot work, the fill material shall be placed in neatly horizontal layers, having a maximum loose thickness of four (4) to six (6) inches.
 - 5. Underslab fill and backfill shall be placed and compacted before installation of underfloor mechanical lines. Underslab subbase material shall be installed after underslab mechanical lines have been installed, backfilled, and compacted.
 - 6. At the time of compaction, the material in each layer of fill shall have moisture content within +/-2 percent of optimum moisture as determined by ASTM D-1557. If, in the opinion of the Soils Testing Agency, the fill material is too wet, the fill shall be dried by a method approved by the Soils Testing Agency prior to commencing or continuing the compaction operation. If, in the opinion of the Soils Testing Agency, the fill materials are too dry for proper compaction, the fill shall be moistened by a method approved by the Soils Testing Agency prior to commencing or continuing the compaction operation.

7. Avoid routing of construction equipment, including loaded trucks, over approved subgrade or compacted areas.

D. Compaction of Fill:

1. Uniformly spread each layer, moisten or dry as required for optimum moisture content, and then compact so density of the compacted material meets or exceeds the specified percentages below.

<u>Percentage of Maximum Dry Density</u>	<u>Location</u>
95	Above foundations, and below slab on grade construction pavement and beneath utilities.
90	Non-loaded grassed areas, as shown.

2. Any lift, or portion thereof, which is not compacted in accordance with Specifications shall be recompacted or removed and replaced to the satisfaction of the Soils Testing Agency. The degree of compaction of each lift shall be checked by the Soils Testing Agency, and each successive lift shall not be placed, or compacted, until the previous lift is tested and approved by the Soils Testing Agency. This fill is to be compacted to the lines and grades specified.

3.12 ROUGH GRADING

- A. Subgrade - Depth below finished grade as required for building construction, topsoil, or pavement.
- B. Accuracy - Set grade stakes where spot elevations are shown, at breaks in grade, along drainage "swales" and as otherwise required to correctly grade the area according to elevations shown on plans. Maximum spacing of stakes to be 50 feet on center.
- C. Grade not otherwise indicated shall be uniform levels or slopes between points where elevations are given or between such points and existing finished grades. Abrupt changes in slopes shall be rounded. All new grades, other than grades for paved areas, to be within plus or minus 0.50" of grades indicated on Drawings or in Specifications.
- D. Grade for paved areas, both subgrade and base courses, to be plus or minus 0.25" of indicated grades.

3.14 SPECIAL CONSIDERATIONS

Some locations of the site may warrant special consideration due to the presence of unknown below grade obstructions. Such conditions must be brought to the attention of the Architect/Engineer for evaluation before work progresses.

3.15 SETTLEMENT

Repair to proper grade any settlement of slab, pavement, utility, structure, or lawn, adversely affected by settlement, within one year after final acceptance at no expense to the Owner.

PART 4 - MEASUREMENT AND PAYMENT

- 4.01 Excavation and backfill requested by the Architect or Soils Testing Agency to remove deficient or deleterious materials below specified grades shall be paid for at the bid unit price per cubic yard - measured in place. Such payment shall be full compensation for excavation, disposal and compaction of backfill.
- 4.02 Extraordinary trucking and disposal costs of oil contaminated soil will be paid for in accordance with the "Extra Work" provisions of the Contract. Disposal site and licensed hauling subcontractor shall be subject to the specific approval of the Owner. No extra compensation will be made for stockpiling or special loading required for disposal of oil-contaminated soil.
- 4.03 Rock excavation shall be paid for on the basis of unit prices as listed in the Bid Form. See Section 3.01 for rock pay limits.
- 4.04 Excavation, demolition and backfill requested by the Architect or Soils Testing Agency to remove any existing below grade obstructions below specified grades, shall be paid for at the bid unit price per cubic yard, measured in place. Such payment shall be full compensation for excavation, demolition, disposal and compaction of backfill.
- 4.05 All other work in this section shall be paid for as a lump sum included in base bid.

END OF SECTION 312000

SECTION 321000 - PAVING

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. Testing Laboratory Services: Section 014100.
- B. Excavation, Site Fill and Rough Grading: Section 312000
- C. Concrete: Section 033100.

1.02 SUBMITTALS

- A. Samples:
 - 1. Sub-Base Course Material (If requested).
- B. Product Data:
 - 1. Pavement Sealer, including application instructions.
 - 2. Expansion Joint Filler.
 - 3. Expansion Joint Sealant.
 - 4. Pavement Marking Paint.

PART 2 - PRODUCTS

2.01 BITUMINOUS PAVING MATERIALS

- A. Sub-Base Course - Run-Of-Crusher Stone:
 - 1. Conform with NYSDOT Section 304.12.
 - 2. Material shall be stone or blast furnace slag. (Open hearth slag or sand and gravel will not be accepted.)
 - 3. 100 percent passing 2 inch sieve, 25-60 percent passing 1¼ inch sieve, 5-40 percent passing No. 40 sieve, 0-10 percent passing No. 200 sieve.
- B. Asphalt Top Course - Vehicular:
 - 1. Conform with NYSDOT Table 608-2
 - 2. Binder/base: NYSDOT Section 402.198203-19, F9-80 series compaction.
 - 3. Topping: NYSDOT Section 402.099803-9.5, F2-80 series compaction.

C. Tack Coat:

1. NYSDOT Asphalt Emulsion Item 407.0102.
2. Asphalt Joint Adhesive Item 418.7603

D. Bituminous Pavement Sealer:

1. Acceptable Products:

- a. Sealtight Driveway Sealer by W. R. Meadows, Inc.
- b. Playtime Pavement Sealer by Playtime U.S.A., Inc.
- c. Jennite J-16 by Maintenance, Inc.

2. Material:

- a. A coal tar emulsion material specifically formulated to seal asphalt concrete pavement.
- b. Add four pounds of sand per gallon of undiluted pavement sealer and mix to a uniform consistency.
- c. Sand: Clean, hard, and durable, free from clay, salt and organic matter, and well graded within the following limits:

<u>U.S. Sieve</u>	<u>Total % Passing</u>
No. 16	100%
No. 20	80 to 100%
No. 30	50 to 90%
No. 50	20 to 60%
No. 100	0 to 5%

- d. Dilute sealer with potable water in accordance with the manufacturer's recommendations.

2.02 CONCRETE PAVEMENT AND CURB MATERIALS

A. Sub-Base Course - Run-Of Crusher Stone:

1. Conform with NYSDOT 304.12
2. Material shall be stone or blast furnace slag. (Open hearth slag or sand and gravel will not be accepted.)
3. 100 percent passing 2 inch sieve, 25-60 percent passing 1/4 inch sieve, 5-40 percent passing No. 40 sieve, 0-10 percent passing No. 200 sieve.

- B. Concrete:
 - Class A, 4000 psi - Refer to Section 033100
- C. Reinforcement:
 - As specified in Section 033001
- D. Expansion Joint Filler:
 - 1. Material:
 - a. Fiber expansion joint, ASTM D1751.
 - b. 1/2" thick, unless otherwise indicated.
 - 2. Acceptable Products:
 - a. Fibre Expansion Joint by W. R. Meadows, Inc.
 - b. Flexcell by The Celotex Corp.
 - c. Accepted equal
- E. Expansion Board and Cap & Pull Off Top:
 - 1. Greenstreak Removable Top-Expansion Joint Cap #941, #942.
 - 2. Vinylex Corp. Removable Cap Strip Vp 1391, VP 1393.
 - 3. Accepted equal.
- F. Doweled Joint Material:
 - 1. 3/4" x 1'-4" smooth dowels with dowel caps equivalent to No. 87 by Heckman Building Products, Inc.
 - 2. Grease end of dowel prior to installing cap.
- G. Expansion Joint Sealant:
 - 1. Material:
 - a. Two component Polyurethane Sealant, self-leveling.
 - b. ASTM TT-S-00227E or TT-S-00230C Type 1, Class A.
 - 2. Acceptable Products:
 - a. Pourthane by W. R. Meadows, Inc.

- b. THC-900 by Tremco Manufacturing Company.
 - c. Accepted equal.
 - H. Concrete Curb Expansion Joint Sealant:
 - 1. Material:
 - a. Multi-Component Urethane Sealant.
 - b. Federal Specification TT-S-00227E, Type II, Class A.
 - 2. Acceptable Products:
 - a. Dymeric by Tremco Manufacturing Company.
 - b. Sonolastic NP II by Sonneborn Building Products.
 - I. Expansion Joint Backer Rod:
 - 1. Acceptable Products:
 - a. Sonoform by Sonneborn Building Products.
 - b. Ethafoam by Dow Chemical Company.
 - c. Sealtight Backer Rod by W. R. Meadows, Inc.
 - d. Accepted equal.
 - 2. Size: To allow 30% compression when inserted in joint.

2.03 PAVEMENT MARKING PAINT

- A. Acceptable Products:
 - 1. Traffic Marking Paint by Sherwin Williams.
 - 2. Hi-High Plexicolor Line Paint by California Products Corp.
- B. Color: White, Yellow, Blue

PART 3 - EXECUTION

3.01 SUBGRADE PREPARATION UNDER PAVEMENT

Fine grade and proof roll all areas in accordance with NYSDOT Specifications 203-3.14.

3.02 BITUMINOUS PAVING

A. All Courses:

1. Roll each course with 10 ton roller or equivalent.
2. Commence rolling along lower edge and continue until edge is thoroughly compacted, after which gradually advance to the crown.
3. Continue rolling until the layer has become thoroughly compacted and is true to grade and cross section.

B. Sub-Base Course:

1. Place on dry subgrade in maximum lifts of 6".
2. Remove subgrade material, which becomes mixed with base course and reconstruct.
3. Minimum Compaction: 95% of maximum density.
4. Grade Tolerance: Plus or minus 3/8" from indicated grades.

C. Asphalt Top Course:

1. Do not install asphalt paving over wet base course or if ambient temperature is below 50 degrees F.
2. Place in two courses to compacted thickness as detailed.
3. Where pavement abuts curbs, concrete walks, or existing pavement, apply a liberal application of tack coat material.
4. Check with 10' straight edge and correct all depressions and high areas greater than 1/4".
5. Form or cut all pavement edges to clean, sharp lines or radius, as indicated.
6. Compaction for wearing course shall be minimum of 92% of Laboratory Specimen density.

3.03 PAVEMENT SEALER

- A. Allow pavement to weather a minimum of four weeks prior to sealing.
- B. Clean surface of dirt and other foreign matter.
- C. Apply two coats of sealer uniformly at a minimum total coverage of 0.18 gallons per square yard per coat.
- D. Required for all parking areas and lots. (Not on roadways)

- E. Allow a minimum of 24 hours for curing prior to checking sealed pavement for vehicle usage.

3.04 PAVEMENT MARKING

- A. Apply one coat of pavement marking paint where indicated.
- B. Apply by brush or zone marking equipment.

3.05 CONCRETE PAVING - VEHICULAR

A. Sub-Base Course:

1. Place on dry subgrade in maximum lifts of 6" and compact with a 10 ton roller or equivalent.
2. Commence rolling along lower edge and continue until edge is thoroughly compacted, after which gradually advance to the crown.
3. Continue rolling until the layer has become thoroughly compacted and is true to grade and cross section.
4. Remove subgrade material, which becomes mixed with base course and reconstruct.
5. Minimum Compaction: 95% of maximum density.
6. Grade Tolerance: Plus or minus 3/8" from indicated grades.

B. Concrete Reinforcement:

1. 6 x 6 - W2.9 x W2.9 unless other size is indicated.
2. Top of slab to reinforcement: 1/3 slab depth.
3. Place reinforcement in accordance with Section 033100.

C. Concrete:

1. Place, cure and protect in accordance with Section 033100.
2. Finish: Screed to grade, wood float and give a final fine broom finish. Edge all sides.

D. Expansion Joints:

1. Install expansion joint filler where concrete pavement abuts building foundations, steps, other concrete structures and elsewhere where indicated.

2. Remove perforated cap from premold filler.
3. Install backer rod to uniform depth to allow application of sealant to depth recommended by the manufacturer for indicated joint width.
4. Apply manufacturers recommended primer and fill joint with expansion joint sealant.

E. Dowelled Expansion Joint:

After concrete has cured, remove strip from premolded joint filler and fill joint with sealant flush with concrete.

3.06 CONCRETE PAVING - SIDEWALKS

A. Sub-Base Course:

1. Place on dry subgrade and compact with a 10 ton roller or equivalent. Continue rolling until course is thoroughly compacted and true to grade and cross section.
2. Remove subgrade material, which becomes mixed with base course and reconstruct.
3. Minimum Compaction: 95% of maximum density.
4. Grade Tolerance: Plus or minus 1/4" from indicated grades.

B. Concrete Reinforcement:

1. 6 x 6 - W1.4 x W1.4 unless other size is indicated.
2. Top of slab to reinforcement: 1/3 slab depth.
3. Place reinforcement in accordance with Section 033100.

C. Concrete:

1. Place, cure and protect in accordance with Section 033100.
2. Finish: Screed to grade, wood float and give a fine broom finish.

D. Expansion Joints:

1. Install expansion joint filler:
 - a. Where concrete walks abut building foundations, perpendicular curbs, steps or concrete structures.
 - b. Across walks at maximum intervals of 30 linear feet.

- c. Other locations indicated on the drawings.
 - 2. Remove perforated strip-off cap from premolded joint filler.
 - 3. Apply manufacturer's recommended primer and fill joint with expansion joint sealant.
- E. Scored Joints:
- 1. Use tool, which produces a "V" joint 1/2" depth and not over 1/4" wide.
 - 2. Locate joints across walks at intervals of 5'-0", unless otherwise indicated.
 - 3. Walks wider than 5 feet: Provide 5'-0" square pattern, unless otherwise indicated.

3.07 CONCRETE CURBS

- A. Reinforcement:
- One No. 5 bar top and bottom, except provide smooth doveled slip joint at expansion joints.
- B. Concrete:
- 1. Place, cure and protect in accordance with Section 033100.
 - 2. Uniform smooth finish on all exposed surfaces.
- C. Expansion Joints:
- 1. Construct expansion joints at maximum intervals of 30 feet and at beginning and end of radius.
 - 2. Install expansion joint filler to within approximately 3/4" of surface of concrete.
 - 3. Install backer rod to uniform depth to allow application of sealant to depth recommended by the manufacturer for indicated joint width.
 - 4. Apply primer, if recommended by the manufacturer, and fill joint with concrete curb expansion joint sealant. Tool slightly concave.

END OF SECTION 321000

SECTION 329000 - PLANTING

1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes provisions for the following items:
 - 1. Shrubs.
 - 2. Lawns.
 - 3. Soil amendments.
 - 4. Initial maintenance of landscape materials.
- B. Related Sections: The following sections contain requirements that relate to this Section.
 - 1. Excavation, filling, and rough grading required to establish elevations shown on drawings is specified in "Earthwork."

1.03 QUALITY ASSURANCE

- A. Subcontract landscape work to a single firm specializing in landscape work.
- B. Source Quality Control:
 - 1. General: Ship landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials.
 - 2. Do not make substitutions. If specified landscape material is not obtainable, submit proof of non-availability to Engineer, together with proposal for use of equivalent material.
 - 2. Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.
 - 3. Topsoil: Before delivery of topsoil, furnish Engineer with written statement giving location of properties from which topsoil is to be obtained, names and addresses of owners, depth to be stripped, and crops grown during past 2 years.

4. Trees, Shrubs and Plants: Provide trees, shrubs, and plants of quantity, size, genus, species, and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 "American Standard for Nursery Stock". Provide healthy, vigorous stock, grown in recognized nursery in accordance with good horticultural practice and free of disease, insects, eggs, larvae, and defects such as knots, sun-scald, injuries, abrasions, or disfigurement.
5. Label each tree and shrub with securely attached waterproof tag bearing legible designation of botanical and common name.
6. Inspection: The Architect may inspect trees and shrubs either at place of growth or at site before planting, for compliance with requirements for genus, species, variety, size, and quality. The Architect retains right to further inspect trees and shrubs for size and condition of balls and root systems, insects, injuries and latent defects, and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from project site.

1.04 SUBMITTALS

- A. General: Submit the following:
- B. Plant and Material Certifications:
 1. Manufacturer's or vendor's certified analysis for soil amendments and fertilizer materials.
 2. Label data substantiating that plants, trees, shrubs and planting materials comply with specified requirements.
 3. Seed vendor's certified statement for each grass seed mixture required, stating botanical and common name, percentages by weight, and percentages of purity, germination, and weed seed for each grass seed species.
- C. Planting Schedule: Proposed planting schedule, indicating dates for each type of landscape work during normal seasons for such work in area of site. Correlate with specified maintenance periods to provide maintenance from date of substantial completion. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.
- D. Maintenance Instructions: Typewritten instructions recommending procedures to be established by Owner for maintenance of landscape work for one full year. Submit prior to expiration of required maintenance period(s).

1.05 DELIVERY, STORAGE AND HANDLING

- A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.

- B. Sod: Time delivery so that sod will be placed within 24 hours after stripping. Protect sod against drying and breaking of rolled strips.
- C. Trees and Shrubs: Provide freshly dug trees and shrubs. Do not prune prior to delivery unless otherwise approved by Architect. Do not bend or bind-tie trees or shrubs in such manner as to damage bark, break branches, or destroy natural shape. Provide protective covering during delivery. Do not drop balled and burlapped stock during delivery.
- D. Deliver trees and shrubs after preparations for planting have been completed and plant immediately. If planting is delayed more than 6 hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and keep roots moist by covering with mulch, burlap or other acceptable means of retaining moisture.
- E. Do not remove container-grown stock from containers until planting time.

1.06 JOB CONDITIONS

- A. Utilities: Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.
- B. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify ARCHITECT before planting.

1.07 SEQUENCING AND SCHEDULING

- A. Planting Time: Proceed with, and complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.
 - 1. Plant or install materials during normal planting seasons for each type of plant material required.
 - 2. Correlate planting with specified maintenance periods to provide maintenance from date of substantial completion.
- B. Coordination with Lawns: Plant trees and shrubs after final grades are established and prior to planting of lawns, unless otherwise acceptable to Engineer. If planting of trees and shrubs occurs after lawn work, protect lawn areas and promptly repair damage to lawns resulting from planting operations.

1.08 SPECIAL PROJECT WARRANTY

- A. Warranty trees and shrubs, for a period of one year after date of substantial completion, against defects including death and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents which are beyond Landscape Installer's control.
- B. Remove and replace trees, shrubs, or other plants found to be dead or in unhealthy condition during warranty period. Make replacements during growth season following

end of warranty period. Replace trees and shrubs, which are in doubtful condition at end of warranty period; unless, in opinion of Engineer, it is advisable to extend warranty period for a full growing season.

1. Another warranty inspection will be conducted at end of extended warranty period, if any, to determine acceptance or rejection. Only one replacement (per tree, shrub or plant) will be required at end of warranty period, except for losses or replacements due to failure to comply with specified requirements.

2 - PRODUCTS

2.01 TOPSOIL

- A. Topsoil is not available for re-use in landscape work. Provide topsoil as required to complete landscape work.
- B. Provide new topsoil that is fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than 2 inches in any dimension, and other extraneous or toxic matter harmful to plant growth.
 1. Obtain topsoil from local sources or from areas having similar soil characteristics to that found at project site. Obtain topsoil only from naturally, well-drained sites where topsoil occurs in a depth of not less than 4 inches. Do not obtain from bogs or marshes.

2.02 SOIL AMENDMENTS

- A. Lime: Natural dolomitic limestone containing not less than 85 percent of total carbonates with a minimum of 30 percent magnesium carbonates, ground so that not less than 90 percent passes a 10-mesh sieve and not less than 50 percent passes a 100-mesh sieve.
- B. Aluminum Sulfate: Commercial grade.
- C. Peat Humus: Finely divided peat, so completely decomposed and free of fibers that its biological identity is lost. Provide in granular form, free of hard lumps and with pH range suitable for intended use.
- D. Bonemeal: Commercial, raw, finely ground; 4 percent nitrogen and 20 percent phosphoric acid.
- E. Superphosphate: Soluble mixture of treated minerals; 20 percent available phosphoric acid.
- F. Sand: Clean, washed sand, free of toxic materials.
- G. Perlite: Conforming to National Bureau of Standards PS 23.
- H. Vermiculite: Horticultural grade, free of toxic substances.

- I. Sawdust: Rotted sawdust, free of chips, stones, sticks, soil, or toxic substances and with 7.5 pounds of nitrogen uniformly mixed into each cubic yard of sawdust.
- J. Manure: Well rotted, unleached stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials and containing no chemicals or ingredients harmful to plants.
- K. Mulch: Organic mulch free from deleterious materials and suitable for top dressing of trees, shrubs, or plants and consisting of one of the following:
 - 1. Shredded hardwood
 - 2. Ground or shredded bark
 - 3. Wood chips
 - 4. Pine needles
- L. Commercial Fertilizer: Complete fertilizer of neutral character, with some elements derived from organic sources and containing following percentages of available plant nutrients:
 - 1. For trees and shrubs, provide fertilizer with not less than 5 percent total nitrogen, 10 percent available phosphoric acid and 5 percent soluble potash.
 - 2. For lawns, provide fertilizer with percentage of nitrogen required to provide not less than 1 pound of actual nitrogen per 1,000 sq. ft. of lawn area and not less than 4 percent phosphoric acid and 2 percent potassium. Provide nitrogen in a form that will be available to lawn during initial period of growth; at least 50 percent of nitrogen to be organic form.

2.03 PLANT MATERIALS

- A. Quality: Provide trees, shrubs, and other plants of size, genus, species, and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 "American Standard for Nursery Stock".
- B. Deciduous Shrubs: Provide shrubs of the height shown or listed and with not less than minimum number of canes required by ANSI Z60.1 for type and height of shrub required.
 - 1. Provide balled and burlapped (B&B) deciduous shrubs.
 - 2. Container grown deciduous shrubs will be acceptable in lieu of balled and burlapped deciduous shrubs subject to specified limitations for container grown stock.
- D. Coniferous and Broadleafed Evergreens: Provide evergreens of sizes shown or listed. Dimensions indicate minimum spread for spreading and semi-spreading type evergreens and height for other types, such as globe, dwarf, cone, pyramidal, broad upright, and columnar. Provide normal quality evergreens with well-balanced form complying with requirements for other size relationships to the primary dimension shown.
 - 1. Provide balled and burlapped (B&B) evergreens.
 - 2. Container grown evergreens will be acceptable, subject to specified limitations for container grown stock.

2.04 GRASS MATERIALS

- A. Grass Seed: Provide fresh, clean, new-crop seed complying with tolerance for purity and germination established by Official Seed Analysts of North America. Provide seed mixture composed of grass species, proportions and minimum percentages of purity, germination, and maximum percentage of weed seed, as specified.
- B. Sod: Provide strongly rooted sod, not less than 2 years old, free of weeds and undesirable native grasses, and machine cut to pad thickness of 3/4 inch (plus or minus 1/4 inch), excluding top growth and thatch. Provide only sod capable of vigorous growth and development when planted (viable, not dormant).
 - 1. Provide sod of uniform pad sizes with maximum 5 percent deviation in either length or width. Broken pads or pads with uneven ends will not be acceptable. Sod pads incapable of supporting their own weight when suspended vertically with a firm grasp on upper 10 percent of pad will be rejected.
 - 2. Provide sod composed principally of following:
 - a. Kentucky Bluegrass (*Poa pratensis*).
 - b. Bermuda grass (*Cynodon dactylon*).
 - c. St. Augustinegrass (*Stenotaphrum secundatum*).
 - d. Centipedegrass (*Eremochloa ophiuroides*).

2.05 MISCELLANEOUS LANDSCAPE MATERIALS

- A. Wood Headers and Edging: Of sizes shown and following wood species.
 - 1. All Heart Redwood.
 - 2. Tidewater Red Cypress, All Heartwood.
 - 3. Western Red Cedar, All Heart.
 - 4. Southern Pine, pressure treated with water-borne preservative for ground contact use complying with AWPB LP-22.
 - 5. Provide wood stakes of the same species, 2" by 2" by 24" long and with galvanized nails for anchoring headers and edging.
- B. Gravel: Water-worn, hard, durable gravel, washed free of loam, sand, clay, and other foreign substances, and of following size range and color:
 - Size Range: 3/8-inch maximum, 1/8-inch minimum (pea gravel) Color: Readily-available natural gravel color range.

- C. Anti-Erosion Mulch: Provide clean, seed-free salt hay or threshed straw of wheat, rye, oats, or barley.
- D. Anti-Desiccant: Emulsion type, film-forming agent designed to permit transpiration, but retard excessive loss of moisture from plants. Deliver in manufacturer's fully identified containers and mix in accordance with manufacturer's instructions.
- E. Plastic Sheet: Black, weather-resistant polyethylene sheeting, .008 inch (8-mils) thick.
- F. Filtration/Separation Fabric: Water permeable filtration fabric of fiberglass or polypropylene fabric.
- G. Wrapping: Tree-wrap tape not less than 4 inches wide, designed to prevent borer damage and winter freezing.
- H. Stakes and Guys: Provide stakes and deadmen of sound new hardwood, treated softwood, or redwood, free of knot holes and other defects. Provide wire ties and guys of 2-strand, twisted, pliable galvanized iron wire, not lighter than 12 ga. with zinc-coated turnbuckles. Provide not less than 1/2-inch diameter rubber or plastic hose, cut to required lengths and of uniform color, material, and size to protect tree trunks from damage by wires.

3 - EXECUTION

3.01 PREPARATION - GENERAL

- A. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and secure Architect's acceptance before start of planting work. Make minor adjustments as may be required.

3.02 PREPARATION OF PLANTING SOIL

- A. Before mixing, clean topsoil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.
- B. Mix specified soil amendments and fertilizers with topsoil at rates specified. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days.
- C. For pit and trench type backfill, mix planting soil prior to backfilling, and stockpile at site.
- D. For planting beds and lawns, mix planting soil either prior to planting or apply on surface of topsoil and mix thoroughly before planting.
 - 1. Mix lime with dry soil prior to mixing of fertilizer.
 - 2. Prevent lime from contacting roots of acid-loving plants.
 - 3. Apply phosphoric acid fertilizer (other than that constituting a portion of complete fertilizers) directly to subgrade before applying planting soil and tilling.

3.03 PREPARATION FOR PLANTING LAWNS

- A. Loosen subgrade of lawn areas to a minimum depth of 4 inches. Remove stones measuring over 1-1/2 inches in any dimension. Remove sticks, roots, rubbish, and other extraneous matter. Limit preparation to areas, which will be planted promptly after preparation.
 - 1. Spread top soil to minimum depth required to meet lines, grades, and elevations shown, after light rolling and natural settlement. Add specified soil amendments and mix thoroughly into upper 4 inches of topsoil.
 - 2. Place approximately 1/2 of total amount of top soil required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil. Add specified soil amendments and mix thoroughly into upper 4 inches of topsoil.
- B. Preparation of Unchanged Grades: Where lawns are to be planted in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil for lawn planting as follows: Till to a depth of not less than 6 inches. Apply soil amendments and initial fertilizers as specified. Remove high areas and fill in depressions. Till soil to a homogenous mixture of fine texture, free of lumps, clods, stones, roots and other extraneous matter.
 - 1. Prior to preparation of unchanged areas, remove existing grass, vegetation and turf. Dispose of such material outside of Owner's property. Do not turn existing vegetation over into soil being prepare for lawns.
 - 2. Allow for sod thickness in areas to be sodded.
 - 3. Apply specified commercial fertilizer at rates specified and thoroughly mix into upper 2 inches of topsoil. Delay application of fertilizer if lawn planting will not follow within a few days.
- C. Fine grade lawn areas to smooth, even surface with loose, uniformly fine texture. Roll, rake, and drag lawn areas, remove ridges and fill depressions, as required to meet finish grades. Limit fine grading to areas, which can be planted immediately after grading.
- D. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.
- E. Restore lawn areas to specified condition, if eroded or otherwise disturbed, after fine grading and prior to planting.

3.04 PREPARATION OF PLANTING BEDS

- A. Loosen subgrade of planting bed areas to a minimum depth of 6 inches using a culti-mulcher or similar equipment. Remove stones measuring over 1 1/2 inches in any dimension. Remove sticks, stones, rubbish, and other extraneous matter.
- B. Spread planting soil mixture to minimum depth required to meet lines, grades, and elevations shown, after light rolling and natural settlement. Place approximately 1/2 of

total amount of planting soil required. Work into top of loosened subgrade to create a transition layer, then place remainder of the planting soil.

- C. Dig beds not less than 8 inches deep and mix with specified soil amendments and fertilizers.
- D. Remove 8 inches to 10 inches of soil and replace with prepared planting soil mixture.
- E. Planters: Place not less than 4 inch layer of gravel in bottom of planters, install filtration/separation fabric and fill with planting soil mixture consisting of 1 part topsoil, 1 part coarse sand, 1 part peat humus, and 3 lbs. dolomitic limestone per cubic yard of mix. Place soil in lightly compacted layers to an elevation 1-1/2 inches below top of planter allowing for natural settlement.

3.05 EXCAVATION FOR TREES AND SHRUBS

- A. Excavate pits, beds, and trenches with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.
 - 1. For balled and burlapped (B&B trees and shrubs), make excavations at least half again as wide as the ball diameter and equal to the ball depth, plus following allowance for setting of ball on a layer of compacted backfill:
 - a. Allow for 3 inch thick setting layer of planting soil mixture.
 - 2. For container grown stock, excavate as specified for balled and burlapped stock, adjusted to size of container width and depth.
- B. Dispose of subsoil removed from planting excavations. Do not mix with planting soil or use as backfill.
- C. Fill excavations for trees and shrubs with water and allow water to percolate out prior to planting.

3.06 PLANTING TREES AND SHRUBS

- A. Set balled and burlapped (B&B) stock on layer of compacted planting soil mixture, plumb and in center of pit or trench with top of ball at same elevation as adjacent finished landscape grades. Remove burlap from sides of balls; retain on bottoms. When set, place additional backfill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately 2/3 full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill.
- B. Set container grown stock, as specified, for balled burlapped stock, except cut cans on 2 sides with an approved can cutter; remove bottoms of wooden boxes after partial backfilling so as not to damage root balls.
- C. Dish top of backfill to allow for mulching.

- D. Mulch pits, trenches, and planted areas. Provide not less than following thickness of mulch, and work into top of backfill and finish level with adjacent finish grades.
 - 1. Provide 3 inches thickness of mulch.
- E. Apply anti-desiccant, using power spray, to provide an adequate film over trunks, branches, stems, twigs and foliage.
 - 1. If deciduous trees or shrubs are moved when in full-leaf, spray with anti-desiccant at nursery before moving and spray again 2 weeks after planting.
- F. Prune, thin out, and shape trees and shrubs in accordance with standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by Architect, do not cut tree leaders, and remove only injured or dead branches from flowering trees, if any. Prune shrubs to retain natural character.
- G. Remove and replace excessively pruned or misformed stock resulting from improper pruning.
- H. Wrap tree trunks of 2 inches caliper and larger. Start at ground and cover trunk to height of first branches and securely attach. Inspect tree trunks for injury, improper pruning and insect infestation and take corrective measures before wrapping.
- I. Guy and stake trees immediately after planting, as indicated.

3.07 SEEDING NEW LAWNS

- A. Do not use wet seed or seed that is moldy or otherwise damaged in transit or storage.
- B. Sow seed using a spreader or seeding machine. Do not seed when wind velocity exceeds 5 miles per hour. Distribute seed evenly over entire area by sowing equal quantity in 2 directions at right angles to each other.
- C. Sow not less than the quantity of seed specified or scheduled.
- D. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with a fine spray.
- E. Protect seeded slopes against erosion with erosion netting or other methods acceptable to the Engineer.
- F. Protect seeded areas against erosion by spreading specified lawn mulch after completion of seeding operations. Spread uniformly to form a continuous blanket not less than 1-1/2 inches loose measurement over seeded areas.
 - 1. Anchor mulch by spraying with asphalt emulsion at the rate of 10 to 13 gallons per 1000 sq. ft. Take precautions to prevent damage or staining of construction or other plantings adjacent to mulched areas.

3.08 HYDROSEEDING NEW LAWNS

- A. Mix specified seed, fertilizer, and pulverized mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogenous slurry suitable for hydraulic application.
- B. Apply slurry uniformly to all areas to be seeded. Rate of application as required to obtain specified seed sowing rate.

3.09 SODDING NEW LAWNS

- A. Lay sod within 24 hours from time of stripping. Do not plant dormant sod or if ground is frozen.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips; do not overlap. Stagger strips to offset joints in adjacent courses. Work from boards to avoid damage to subgrade or sod. Tamp or roll lightly to ensure contact with subgrade. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering of adjacent grass.
 - 1. Anchor sod on slopes with wood pegs to prevent slippage.
- C. Water sod thoroughly with a fine spray immediately after planting.

3.10 RECONDITIONING EXISTING LAWNS

- A. Recondition existing lawn areas damaged by Contractor's operations including storage of materials and equipment and movement of vehicles. Also recondition existing lawn areas where minor regrading is required.
- B. Provide fertilizer, seed or sod, and soil amendments as specified for new lawns, and as required, to provide a satisfactorily reconditioned lawn.
- C. Provide new topsoil, as required, to fill low spots and meet new finish grades.
- D. Cultivate bare and compacted areas thoroughly to provide a satisfactory planting bed.
- E. Remove diseased and unsatisfactory lawn areas; do not bury into soil. Remove topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, stone, gravel, and other loose building materials.
- F. Where substantial lawn remains, but is thin, mow, rake, aerate if compacted, fill low spots, remove humps, and cultivate soil, fertilize, and seed. Remove weeds before seeding, or if extensive, apply selective chemical weed killers as required. Apply a seedbed mulch, if required, to maintain moist condition.
- G. Water newly planted lawn areas and keep moist until new grass is established.

3.11 MISCELLANEOUS LANDSCAPE WORK

- A. Install wood headers and edgings where indicated. Anchor with wood stakes spaced not more than 3 feet o.c., and driven at least 1 inch below top elevation of header or edging. Use 2 galvanized nails per stake to fasten headers and edging, and clinch point of each nail.
- B. Place gravel beds where indicated. Compact soil subgrades before placing gravel.
 - 1. Lay 8-mil polyethylene plastic film continuously over compacted subgrade prior to placing gravel. Overlap edges 4 inches at joints between sheets.

3.12 MAINTENANCE

- A. Begin maintenance immediately after planting.
- B. Maintain trees, shrubs, and other plants until final acceptance, but in no case, less than following period:
 - 1. 60 days after substantial completion of planting.
- C. Maintain trees, shrubs, and other plants by pruning, cultivating, and weeding as required for healthy growth. Restore planting saucers. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required. Restore or replace damaged wrappings. Spray as required to keep trees and shrubs free of insects and disease.
- D. Maintain lawns for not less than the period stated below, and longer as required to establish an acceptable lawn.
 - 1. Seeded lawns, not less than 60 days after substantial completion.
 - a. If seeded in fall and not given full 60 days of maintenance, or if not considered acceptable at that time, continue maintenance the following spring until acceptable lawn is established.
 - 2. Sodded lawns, not less than 30 days after substantial completion.
- E. Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading and replanting as required to establish a smooth, acceptable lawn, free of eroded or bare areas.

3.13 CLEANUP AND PROTECTION

- A. During landscape work, keep pavements clean and work area in an orderly condition.
- B. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.14 INSPECTION AND ACCEPTANCE

- A. When landscape work is completed, including maintenance, Architect will, upon request, make an inspection to determine acceptability.
 - 1. Landscape work may be inspected for acceptance in portions as agreeable to Architect, provided each portion of work offered for inspection is complete, including maintenance.
- B. When inspected landscape work does not comply with requirements, replace rejected work and continue specified maintenance until reinspected by Architect and found to be acceptable. Remove rejected plants and materials promptly from project site.

END OF SECTION 329000

SECTION 331000 - WATERLINES

1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes water service piping and appurtenances from the source of potable water to a point 5 feet outside the building.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section "Earthwork" for excavation and backfill required for water service piping and structures.
 - 2. Section "Concrete" for supports and structures.
 - 3. Section "Water Distribution Piping" for interior building water piping systems and equipment.

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for valves, water meter, and identification devices.
- C. Coordination drawings showing pipe sizes, and valves and meter locations and elevations. Include details of underground structures, connections, anchors, and reaction backing. Show other piping in the same trench and clearances from water service piping. Indicate interface and spatial relationship between piping and proximate structures.
- D. Coordination profile drawings showing water service piping in elevation. Draw profiles at a horizontal scale of not less than 1 inch equals 50 feet and a vertical scale of not less than 1 inch equals 5 feet. Indicate pipe, valves, structures, meter, anchors, and reaction backing. Show types, sizes, materials, and elevations of other utilities crossing water service piping.
- E. Record drawings at project closeout of installed water service piping and products in accordance with requirements of Division 1.
- F. Maintenance data for valves and water meter, for inclusion in Operating and Maintenance Manuals specified in Division 1 Section "Project Closeout."

1.04 QUALITY ASSURANCE

- A. Comply with requirements of utility supplying water to the project.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves for shipping as follows:
 - 1. Ensure valves are dry and internally protected against rust and corrosion.
 - 2. Protect valves against damage to threaded ends, flange faces, and weld ends.
 - 3. Set valves in best position for handling. Set gate valves closed to prevent rattling.
- B. Storage: Use the following precautions for valves during storage:
 - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
 - 2. Protect valves from weather. Store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement in watertight enclosures.
- C. Handling: Use a sling to handle valves whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels or stems as lifting or rigging points.

1.06 PROJECT CONDITIONS

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations. Verify that water service piping may be installed in compliance with the original design and referenced standards.

1.07 SEQUENCING AND SCHEDULING

- A. Coordinate connection to public water main with utility company.
- B. Coordinate with interior water distribution piping.
- C. Coordinate with other utility work.

2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include but are not limited to the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Gate Valves:

- a. American Darling Valve; Div. of American Cast Iron Pipe Co.
- b. Clow Valve Co.; Div. of McWane, Inc.
- c. Hammond Valve Corp.
- d. Jenkins Bros.
- e. Kennedy Valve; Div. of McWane, Inc.
- f. Milwaukee Valve Co.
- g. Mueller-Hersey; A Grinnell Co.
- h. Nibco, Inc.
- i. Stockham Valve & Fittings, Inc.
- j. U.S. Pipe & Foundry Co.
- k. Waterous Co.

2. Bronze Corporation Stops and Valves:

- a. Ford Meter Box Co., Inc.
- b. Hays Div.; Romac Industries.
- c. McDonald, A.Y., Mfg. Co.
- d. Mueller-Hersey; A Grinnell Co.

3. Drilling Machine Corporation Stops:

- a. Ford Meter Box Co., Inc.
- b. Hays Div.; Romac Industries.
- c. Mueller-Hersey; A Grinnell Co.

4. Tapping Valves:

- a. Clow Valve Co.; Div. of McWane, Inc.

- b. Kennedy Valve; Div. of McWane, Inc.
 - c. Mueller-Hersey; A Grinnell Co.
 - d. U.S. Pipe & Foundry Co.
5. Underground Warning Tapes:
- a. Allen Systems, Inc.; Reef Industries, Inc.
 - b. Brady (W.H.) Co.; Signmark Div.
 - c. Calpico, Inc.
 - d. Carlton Industries, Inc.
 - e. EMED Co., Inc.
 - f. Seton Name Plate Co.

2.02 PIPE AND PIPE FITTINGS, GENERAL

- A. Pipe and pipe fitting materials shall be compatible with each other. Where more than one type of material or product is indicated, selection is Installer's option.
- B. Ductile-Iron Pipe 4 Inches and Larger: AWWA C151, Class 50, except that pipe smaller than 6-inch size shall be Class 51.
 - 1. Lining: AWWA C104, cement mortar, sealcoated.
 - 2. Gaskets: AWWA C111.
 - 3. Ductile-Iron and Cast-Iron Fittings: AWWA C110, ductile-iron or cast-iron, 250-psi pressure rating; or AWWA C153, ductile-iron compact fittings, 350-psi pressure rating.
 - a. Lining: AWWA C104, cement mortar.
 - b. Gaskets: AWWA C111, rubber.
 - 4. Encasement: AWWA C105, polyethylene film tube.
- C. PVC (Polyvinyl Chloride) Pipe 4 Inches and Larger: AWWA C900; Class 150; with bell end and elastomeric gasket, with plain end for cast-iron or ductile-iron fittings, or with plain end for PVC elastomeric gasket fittings.
 - 1. Gaskets: ASTM F 477, elastomeric seal.
 - 2. PVC Couplings and Fittings: AWWA C900, with ASTM F 477 elastomeric seal gaskets.

3. Ductile-Iron and Cast-Iron Fittings: AWWA C110, ductile-iron or cast-iron, 250-psi pressure rating; or AWWA C153, ductile-iron compact fittings, 350-psi pressure rating; of dimension to match pipe outside diameter.
 - a. Lining: AWWA C104, cement mortar.
 - b. Gaskets: AWWA C111, rubber.
- D. Copper Water Tube 2 Inches and Smaller: ASTM B 88; Type K, seamless, annealed temper.
 1. Copper Fittings: ANSI B16.22, wrought-copper, solder-joint pressure type.
 - a. Solder Filler Metal: ASTM B 32, Alloy HB; tin-antimony-copper-nickel composition, with 0.10 percent maximum lead content.
 - b. Solder Filler Metal: ASTM B 32, Alloy Sb5; tin (95 percent)-antimony (5 percent), with 0.20 percent maximum lead content.
 - c. Solder Filler Metal: ASTM B 32, Alloy Sn95, Alloy Sn94, or Alloy E; tin (approximately 95 percent)-silver or copper (approximately 5 percent), with 0.10 percent maximum lead content.
 - d. Solder Filler Metal: ASTM B 32, Alloy HA or Alloy HB; tin-antimony-silver-copper-zinc-nickel composition, with 0.10 percent maximum lead content.
- E. Couplings: Iron body sleeve assembly fabricated to match outside diameters of pipes to be joined.
 1. Sleeve: ASTM A 126, Class B, gray iron.
 2. Followers: ASTM A 47, Grade 32510 or ASTM A 536 ductile iron.
 3. Gaskets: Rubber.
 4. Bolts and Nuts: AWWA C111.
 5. Finish: Enamel paint.

2.03 VALVES

- A. Nonrising Stem Gate Valves 3 Inches and Larger: AWWA C500, cast-iron double disc, bronze disc and seat rings, or AWWA C509, resilient seated; bronze stem, cast-iron or ductile-iron body and bonnet, stem nut, 200-psi working pressure, mechanical joint ends.

- B. Rising Stem Gate Valves, 3 Inches and Larger: AWWA C500, cast-iron double disc, bronze disc and seat rings, or AWWA C509, resilient seated; cast-iron or ductile-iron body and bonnet, OS&Y, bronze stem, 200-psi working pressure, flanged ends.
- C. Nonrising Stem Gate Valves, 2 Inches and Smaller: MSS SP-80; body and screw bonnet of ASTM B 62 cast bronze; with Class 125 threaded ends, solid wedge, nonrising copper-silicon alloy stem, brass packing gland, Teflon-impregnated packing, and malleable iron handwheel.
- D. Valve Boxes: Cast-iron box having top section and cover with lettering "WATER," bottom section with base of size to fit over valve and barrel approximately 5 inches in diameter, and adjustable cast-iron extension of length required for depth of bury of valve.
 - 1. Provide a steel tee-handle operating wrench with each valve box. Wrench shall have tee handle with one pointed end, stem of length to operate valve, and socket fitting valve operating nut.
- E. Curb Stops: Bronze body, ground key plug or ball, and wide tee head, with inlet and outlet to match service piping material.
- F. Service Boxes for Curb Stops: PROVIDED & INSTALLED BY ECWA
- G. Tapping Sleeve and Tapping Valve: PROVIDED & INSTALLED BY ECWA
- H. Service Clamps and Corporation Stops: PROVIDED & INSTALLED BY ECWA

2.04 ANCHORAGES

- A. Clamps, Straps, and Washers: ASTM A 506, steel.
- B. Rods: ASTM A 575, steel.
- C. Rod Couplings: ASTM A 197, malleable iron.
- D. Bolts: ASTM A 307, steel.
- E. Cast-Iron Washers: ASTM A 126, gray iron.
- F. Concrete Reaction Backing: Portland cement concrete mix, 3000 psi.
 - 1. Cement: ASTM C 150, Type I.
 - 2. Fine Aggregate: ASTM C 33, sand.
 - 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 - 4. Water: Potable.

2.05 IDENTIFICATION

- A. Metallic-Lined Plastic Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches wide by 4 mils thick, solid blue in color with continuously printed caption in black letters "CAUTION - WATER LINE BURIED BELOW."

3 - EXECUTION

3.01 PREPARATION OF BURIED PIPE FOUNDATION

- A. Grade trench bottom to provide a smooth, firm, stable, and rock-free foundation throughout the length of the piping.
- B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with clean sand or pea gravel to indicated level.
- C. Shape bottom of trench to fit bottom of piping. Fill unevenness with tamped sand backfill. Dig bell holes at each pipe joint to relieve the bells of all loads and to ensure continuous bearing of the pipe barrel on the foundation.

3.02 INSTALLATION OF PIPE AND PIPE FITTINGS

- A. Ductile-Iron Pipe: Install with cement-mortar-lined, ductile-iron or cast-iron, mechanical joint or push-on joint fittings and rubber gaskets in accordance with AWWA C600.
 - 1. Polyethylene Encasement: Install in accordance with AWWA C105.
- B. PVC (Polyvinyl Chloride) Pipe: Install with cement-mortar-lined, ductile-iron or cast-iron, mechanical joint or push-on joint fittings and rubber gaskets in accordance with AWWA M23.
- D. Copper Tube: Install with wrought copper, solder joint, pressure fittings, and Sn95 Tin-Antimony solder in accordance with CDA "Copper Tube" handbook.
- E. PVC (Polyvinyl Chloride) Pipe: Install with PVC, Schedule 40 socket-type, solvent cement or elastomeric gasketed fittings in accordance with manufacturer's installation instructions.
- F. Depth of Cover: Provide minimum cover over piping of 12 inches below average local frost depth or 60 inches below finished grade, whichever is greater.
- G. Water Main Connection: INSTALLED BY ECWA
- H. Water Service Termination: Terminate water service piping 5'-0" from building foundation in location and invert as indicated. Provide temporary pipe plug for piping extension into building.
- I. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed, by tunneling, jacking, or a combination of both.

3.03 INSTALLATION OF VALVES

- A. General Application: Use mechanical joint end valves for 3-inch and larger buried installation. Use threaded and flanged end valves for installation in pits and inside building. Use bronze corporation stops and valves, with ends compatible to piping, for 2-inch and smaller installation.
- B. AWWA-Type Gate Valves: Comply with AWWA C600. Install buried valves with stem pointing up and with cast-iron valve box.
- C. Bronze Corporation Stops and Curb Stops: Comply with manufacturer's installation instructions. Install buried curb stops with head pointed up and with cast-iron curb box.

3.04 INSTALLATION OF ANCHORAGES

- A. Anchorages: Provide anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches.

3.05 APPLICATION OF PROTECTIVE COATINGS

- A. Apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of installed ferrous anchorage devices.

3.06 INSTALLATION OF IDENTIFICATION

- A. Install continuous plastic underground warning tape during back-filling of trench for underground water service piping. Locate 6 to 8 inches below finished grade, directly over piping.
- B. Attach nonmetallic piping label permanently to main electrical meter panel.

3.07 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have sufficiently hardened. Fill pipeline 24 hours prior to testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than 1-1/2 times working pressure for 2 hours.
 - 1. Increase pressure in 50-psi increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0 psi. Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within above limits.

3.08 CLEANING

- A. Clean and disinfect water distribution piping as follows:
 - 1. Purge all new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired, prior to use.

2. Use the purging and disinfecting procedure prescribed by the authority having jurisdiction or, in case a method is not prescribed by that authority, use the procedure described in AWWA C651, or as described below:
 - a. Fill the system or part thereof with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system or part thereof and allow to stand for 24 hours.
 - b. Drain the system or part thereof of the previous solution and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
 - c. Following the allowed standing time, flush the system with clean, potable water until chlorine does not remain in the water coming from the system.
 - d. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.

B. Prepare reports for all purging and disinfecting activities.

3.09 VALVE SCHEDULE

A. Nonrising Stem Gate Valves - 4 Inches and Larger:

AWWA - MECH JT

<u>MANUFACTURER</u>	<u>C500</u>	<u>C509</u>
American Darling	55	85
Clow Valve	F-5065	F-6100
Kennedy Valve	571X	1571X
Mueller-Hersey	A-2380-20	A-2370-20
Stockham Valve	G-743-O	G-701-O
U.S. Pipe	3460	5460
Waterous	300 Series	500 Series

B. Rising Stem Gate Valves - 3 Inches and Larger:

AWWA, FLANGED

<u>MANUFACTURER</u>	<u>C500</u>	<u>C509</u>
American Darling	52	82
Clow Valve	F-5072	F-6136
Kennedy Valve	566	1566
Mueller-Hersey	A-2483-6	A-2373-6
U.S. Pipe	3630	5120
Waterous	300 Series	500 Series

C. Nonrising Stem Gate Valves - 2 Inches and Smaller:

<u>MANUFACTURER</u>	<u>MSS SP-80 THREADED</u>
Hammond Valve Corp.	IB645
Jenkins Bros.	370
Milwaukee Valve Co.	1105M
Nibco	T-113 w/iron HW
Stockham Valve	B-103

D. Tapping Valves:

<u>MANUFACTURER</u>	
American Darling	565 or 865
Clow Valve	F-5093
Kennedy Valve	950X
Mueller-Hersey	H-667
U.S. Pipe	3860

E. Corporation Stops and Curb Stops:

<u>MANUFACTURER</u>	<u>CORP. STOPS</u>	<u>CURB STOPS</u>
Ford Meter Box	F Series	B Series
Hays	5000 Series	4000 Series
McDonald, A.Y.	3100, 4700 Series	6100 Series
Mueller-Hersey	H Series	H Series

END OF SECTION 331000

SECTION 333000 - SANITARY SEWERAGE

1 - GENERAL

1.01 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

- A. This Section includes sanitary sewerage system piping and appurtenances from a point 5 feet outside the building to the point of disposal.
- B. Related Sections: The following sections contain requirements that relate to this section:
 - 1. Section "Earthwork" for excavation and backfill required for sanitary sewerage system piping and structures.
 - 2. Section "Concrete"
 - 3. Section "Sanitary Drainage and Vent Systems" for building sanitary drains.

1.03 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
- B. Product data for drainage piping specialties.
- C. Coordination drawings showing pipe sizes and manholes, locations, and elevations. Include details of underground structures and connections. Show other piping in the same trench and clearances from sanitary sewerage system piping. Indicate interface and spatial relationship between piping and proximate structures.
- D. Coordination profile drawings showing sanitary sewerage system piping in elevation. Draw profiles at a horizontal scale of not less than 1 inch equals 50 feet and a vertical scale of not less than 1 inch equals 5 feet. Indicate pipe and underground structures. Show types, sizes, materials, and elevations of other utilities crossing sewerage system piping.

1.04 QUALITY ASSURANCE

- A. Environmental Compliance: Comply with applicable portions of local environmental agency regulations pertaining to sanitary sewerage systems.
- B. Utility Compliance: Comply with local utility regulations and standards pertaining to sanitary sewerage systems.

1.05 PROJECT CONDITIONS

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations. Verify that sanitary system piping may be installed in compliance with original design and referenced standards.

- 1. Locate existing sanitary sewerage system piping and structures that are to be abandoned and closed.

1.06 SEQUENCING AND SCHEDULING

- A. Coordinate connection to public sewer with utility company.
- B. Coordinate with interior building sanitary drainage piping.
- C. Coordinate with other utility work.

2 - PRODUCTS

2.01 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include but are not limited to the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cleanouts:
 - a. Ancon, Inc.
 - b. Josam Co.
 - c. Smith (Jay R.) Mfg. Co.
 - d. Wade Div.; Tyler Pipe.
 - e. Zurn Industries, Inc.; Hydromechanics Div.
 - 2. Underground Warning Tapes:
 - a. Allen Systems, Inc.; Reef Industries, Inc.
 - b. Brady (W.H.) Co.; Signmark Div.
 - c. Calpico, Inc.
 - d. Carlton Industries, Inc.
 - e. EMED Co., Inc.
 - f. Seton Name Plate Co.

2.02 PIPE AND FITTINGS

- A. General: Provide pipe and pipe fitting materials compatible with each other. Where more than one type of materials or products is indicated, selection is Installer's option.
- B. Hub and Spigot Cast-Iron Soil Pipe and Fittings: ASTM A 74, gray cast iron, for compression gasket joints.
 - 1. Class: Service.
 - 2. Class: Extra Heavy.
 - 3. Gaskets: ASTM C 564, rubber, thickness to match class of pipe.
- C. PVC (Polyvinyl Chloride) Sewer Pipe and Fittings: ASTM D 3034, SDR 35, for solvent cement or elastomeric gasket joints.
 - 1. Solvent Cement: ASTM D 2564.
 - 2. Gaskets: ASTM F 477, elastomeric seal.
- D. Couplings: Rubber or elastomeric sleeve and stainless steel band assembly fabricated to match outside diameters of pipes to be joined.
 - 1. Sleeves: ASTM C 425, rubber for vitrified clay pipe; ASTM C 443, rubber for concrete pipe; ASTM C 564, rubber for cast-iron soil pipe; and ASTM F 477, elastomeric seal for plastic pipe. Sleeves for dissimilar or other pipe materials shall be compatible with pipe materials being joined.
 - 2. Bands: Stainless steel, one at each pipe insert.

2.03 MANHOLES

- A. Precast Concrete Manholes: ASTM C 478, precast reinforced concrete, of depth indicated with provision for rubber gasket joints.
 - 1. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having a separate base slab or section with integral floor.
 - 2. Riser Section: 4-inch minimum thickness; 48-inch diameter, and lengths to provide depth indicated.
 - 3. Top Section: Eccentric cone type, unless concentric cone or flat-slab-top type is indicated. Top of cone to match grade rings.
 - 4. Grade Rings: Provide 2 or 3 reinforced concrete rings, of 6 to 9-inches total thickness and match 24-inch diameter frame cover.
 - 5. Gaskets: ASTM C 443, rubber.

6. Steps: Cast into base, riser, and top sections sidewall at 12 to 16-inch intervals.
 7. Pipe connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.
 8. Channel and Bench: Concrete
- B. Cast-in-Place Manholes: Reinforced concrete of dimensions and with appurtenances indicated.
1. Bottom, Walls, and Top: Reinforced concrete.
 2. Channel and Bench: Concrete.
 3. Steps: Cast into sidewall at 12 to 16-inch intervals.
- C. Concrete: Portland cement mix, 3000 psi.
1. Cement: ASTM C 150, type II.
 2. Fine Aggregate: ASTM C 33, sand.
 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 4. Water: Potable.
- D. Reinforcement: Steel conforming to the following:
1. Fabric; ASTM A 185, welded wire fabric, plain.
 2. Reinforcement Bars: ASTM A 615, Grade 60, deformed.
- E. Manhole Steps: Wide enough for a man to place both feet on one step and designed to prevent lateral slippage off the step.
1. Material: Ductile iron or cast aluminum.
 2. Material: Steel-reinforced plastic.
- F. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, heavy duty, ductile iron, 24-inch inside diameter by 7 to 9-inch riser with 4-inch minimum width flange, and 26-inch diameter cover, indented top design, with lettering "SANITARY SEWER" cast unto cover.

2.04 CLEANOUTS

- A. General: Provide cast-iron ferrule and countersunk brass cleanout plug, with round cast-iron access frame and heavy-duty, secured, scoriated cast-iron cover.

2.05 IDENTIFICATION

- A. Metallic-Lined Plastic Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches wide by 4 mils thick, solid green in color with continuously printed caption in black letters "CAUTION - SEWER LINE BURIED BELOW."

3 - EXECUTION

3.01 PREPARATION OF FOUNDATION FOR BURIED SANITARY SEWERAGE SYSTEMS

- A. Grade trench bottom to provide a smooth, firm, stable, and rock-free foundation, throughout the length of the pipe.
- B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid, and backfill with clean sand or pea gravel to indicated level.
- C. Shape bottom of trench to fit bottom of pipe. Fill unevenness with tamped sand backfill. Dig bell holes at each pipe joint to relieve the bells of all loads and to ensure continuous bearing of the pipe barrel on the foundation.

3.02 PIPE APPLICATIONS FOR UNDERGROUND SANITARY SEWERS

- A. Pipe Sizes 4 to 15 Inches: Service-class hub and spigot cast-iron soil pipe and fittings.
- B. Pipe Sizes 15 Inches and Smaller: PVC solvent cement joint sewer pipe and fittings.
- C. Pipe Sizes 15 Inches and Smaller: PVC gasket joint sewer pipe and fittings.

3.03 INSTALLATION, GENERAL

- A. General Locations and Arrangements: Drawings (plans and details) indicate the general location and arrangement of the underground sanitary sewerage system piping. Location and arrangement of piping layout take into account many design considerations. Install the piping as indicated, to the extent practical.
- B. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.
- C. Use fittings for branch connections, except where direct tap into existing sewer is indicated.
- D. Use proper size increasers, reducers, and couplings, where different size or material of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.
- E. Install piping pitched down in direction of flow, at minimum slope of 2 percent, except where indicated otherwise.

- F. Extend sanitary sewerage system piping to connect to building sanitary drains, of sizes and in locations indicated.
- G. Install 1-inch-thick extruded polystyrene over underground building drain piping not under building. Width of insulation shall extend minimum of 12 inches beyond each side of pipe. Install directly over and center on pipe center line.
- H. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed, by tunneling, jacking, or a combination of both.

3.04 PIPE JOINT CONSTRUCTION AND INSTALLATION

- A. Join and install hub and spigot cast-iron soil pipe and fittings with compression gaskets in accordance with CISPI "Cast Iron Soil Pipe and Fittings Handbook, Volume I." Use "Service" or "Extra Heavy" class gaskets to match class of pipe and fittings.
 - 1. Install polyethylene encasement in accordance with AWWA C105.
- B. Join and install PVC pipe as follows:
 - 1. Solvent cement joint pipe and fittings, joining with solvent cement in accordance with ASTM D 2855 and ASTM F 402.
 - 2. Pipe and gasketed fittings, joining with elastomeric seals in accordance with ASTM D 3212.
 - 3. Installation in accordance with ASTM D 2321.
- C. Join different types of pipe with standard manufactured couplings and fittings intended for that purpose.

3.05 CLEANOUTS

- A. Install cleanouts and extension from sewer pipe to cleanout at grade as indicated. Set cleanout frame and cover in concrete block 18 by 18 by 12 inches deep, except where location is in concrete paving. Set top of cleanout 1 inch above surrounding earth grade or flush with grade when installed in paving.

3.06 TAP CONNECTIONS

- A. Make connections to existing piping and underground structures so that finished work will conform as nearly as practicable to the requirements specified for new work.
- B. Make branch connections from side into existing 24-inch or larger piping or to underground structures by cutting opening into existing unit sufficiently large to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of pipe or structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

1. Provide concrete that will attain minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.
 2. Use epoxy bonding compound as interface between new and existing concrete and piping materials.
- C. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris, concrete, or other extraneous material that may accumulate.

3.07 INSTALLATION OF IDENTIFICATION

- A. Install continuous plastic underground warning tape during back-filling of trench for underground water service piping. Locate 6 to 8 inches below finished grade, directly over piping.

3.08 FIELD QUALITY CONTROL

- A. Testing: Perform testing of completed piping in accordance with local authorities having jurisdiction.
- B. Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
1. In large, accessible piping, brushes and brooms may be used for cleaning.
 2. Place plugs in ends of uncompleted pipe at end of day or whenever work stops.
 3. Flush piping between manholes, if required by local authority, to remove collected debris.
- C. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.
1. Make inspections after pipe has been installed and approximately 2 feet of backfill is in place, and again at completion of project.
 2. If inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects: correct such defects, and reinspect.

END OF SECTION 333000

SECTION 334000- STORM DRAINAGE

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

- A. Excavation for Site Drainage Work: Section 312000.
- B. Backfill above Bedding Material at Storm Drain Lines: Section 312000.
- C. Backfill above Filter Material at Foundation Drains: Section 312000.

1.02 QUALITY ASSURANCE

- A. Code and Regulations:

Comply with all applicable codes, rules and regulations pertaining to storm drainage system.
- B. Coordination:

Coordinate location and inverts of storm lines at 5 feet outside building with plumber.
- C. Verification:

Check inverts of all existing storm structures and pipes to which new lines are to be connected and notify the Owner's Representative of any discrepancy prior to commencement of work.

1.03 SUBMITTALS

- A. Shop Drawings:

For precast concrete drainage structures.
- B. Product Data:

For all standard manufactured products.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Precast Concrete Drainage Structures (Manholes, Catch Basins)
 - 1. Acceptable Manufacturers:
 - a. Kistner Concrete Products, Inc.
 - b. Warren Concrete Products, Inc.

- c. United States Concrete Pipe Co.
 - d. Accepted equal.
 - 2. Material:
 - a. In pavement areas all structures shall be able to support HS-20 loads.
 - b. Comply with ASTM C-478 Specification for Precast Reinforced Concrete Manhole Risers and Tops.
 - c. Joints between units may be one of the following:
 - (1) Flexible watertight rubber gaskets.
 - (2) Portland Cement Mortar.
 - (3) Approved Joint Compound.
 - d. Include aluminum or polypropylene encased steel steps and cast iron traps where indicated and include all required openings.
- B. Storm Drain Piping:
 - 1. HDPE Pipe
 - a. Conforming to:
 - (1) ASTM D1056: Specification for flexible cellular materials, sponge or expanded rubber.
 - (2) ASTM D1248: Specification for polyethylene plastics, molding and extrusion materials.
 - (3) ASTM D3350: Specification for polyethylene plastics, pipe and fittings materials.
 - (4) ASTM D2321: Practice for underground installation of flexible thermoplastic sewer pipe.
 - (5) AASHTO M252: Specification for corrugated polyethylene drainage tubing, 3- to 10-inch diameter.
 - (6) AASHTO M294: Specification for corrugated polyethylene pipe, 12- to 36-inch diameter.
 - b. Joints - seal with flexible silt-tight rubber gaskets, ASTM D 3212.
 - 2. PVC Plastic Pipe
 - a. Material:

Polyvinyl chloride plastic pipe with necessary fittings conforming to ASTM D3034, SDR35.

b. Acceptable Manufacturers:

- (1) Advanced Drainage Systems, Inc.
- (2) Triangle Pipe and Tube Co.
- (3) Carlon/An Indian Head Co.
- (4) Accepted Equivalent

C. Foundation Drains (IF REQD):

Any one of the following materials may be used:

1. Plastic Pipe:

a. Material:

Polyvinyl chloride plastic pipe with necessary fittings conforming to ASTM D3034, SDR35.

b. Acceptable Manufacturers:

- (1) Advanced Drainage Systems, Inc.
- (2) Triangle Pipe and Tube Co.
- (3) Carlon/An Indian Head Co.
- (4) Accepted Equivalent

D. Drainage Structure Castings:

1. Acceptable Manufacturers:

- a. Neenah Foundry Company.
- b. Flockhart Foundry Company.
- c. Accepted Equivalent

2. Catalog numbers on drawings are those of Neenah Foundry Company unless otherwise noted.

3. Material: Gray Iron Castings, ASTM A-48, Class 30.

4. Finish Coating:

One coat of high grade bituminous asphalt paint, Federal Specification Mil-C-450B.

E. Bedding Material:

1. Crushed aggregate conforming with NYSDOT Section 703-02.
2. No. 1 crushed stone (NYSDOT Material Designation 623.03) or No. 1 washed crushed gravel (NYSDOT Material Designation 623.02).
3. 100 percent passing 1" sieve, 90-100 percent passing 1/2" sieve, 0-15 percent passing 1/4" sieve.

F. Filter Material:

1. Crushed aggregate conforming with NYSDOT Section 703-02.
2. No. 1 crushed stone (NYSDOT Material Designation 623.03) or No. 1 washed Crushed Gravel (NYSDOT Material Designation 623.02).
3. 100 percent passing 1" sieve, 90-100 percent passing 1/2" sieve, 0-15 percent passing 1/4" sieve.

PART 3 - EXECUTION

3.01 STORM LINES

- A. Fine grade trench bottom with hand tools to an elevation 6" below the bottom elevation of the pipe.
- B. Place bedding material and thoroughly compact. Thickness: 6" after compaction.
- C. Do not lay pipe in wet trench and do not permit water in trench until joints are completed.
- D. Lay pipe to line and grade with inside joints smooth and uniform. A perfect circle shall be evident when lamped.
- E. Upon completion of lines or portion thereof test for watertightness. Notify Owner's Representative so he may observe testing. Maintain head of water one foot above highest point of line.
- F. Backfill with bedding material to spring line of pipe and compact.

3.02 FOUNDATION DRAINS

- A. Lay lines true to line and grade on a 3" minimum bed of filter material and backfill with filter material to a minimum depth of 24" above top of line, unless otherwise indicated.
- B. Install perforated lines with holes down.

3.03 CONNECTIONS TO EXISTING STRUCTURE

- A. Where pipes are to be connected to existing manholes or other structures, and where no stub or opening has been provided for the connection, make an opening of minimum diameter through the sidewall of the structure for inserting the pipe.
- B. After inserting the pipe, place standard manhole pipe gasket around pipe and completely fill the space remaining outside the pipe with a non-shrink mortar.
- C. Make watertight to prevent leakage of water into the manhole or structure.
- D. Alter concrete paved inverts in existing structures to form a trough, so that new connections enter the existing pipe smoothly and in the direction of flow.
- E. Make connections to existing manholes or structures carefully to avoid damage to the manhole or structure.
- F. Repair any damage resulting from the work.
- G. Prevent debris from entering existing pipes or structures.

END OF SECTION 334000