

PROJECT SPECIFICATIONS / MANUAL

Volume 3

Rye City School District

Midland Elementary School

312 Midland Avenue
Rye, NY 10580

SED Number: #6618-0001-0003-026

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PROJECT TEAM

Architects

Geddis Architects

71 Old Post Road, Suite 101
P.O. Box 1020
Southport, CT 06890
Phone: (203) 256-8700

Fielding International

259 Water Street, Suite 1L
Warren, RI 02885
Phone: (401) 289-2789

Construction Manager

Savin Engineers, PC

3 Campus Drive
Pleasantville, NY 10570
Phone: (914) 769-3200

Structural Engineer

Odeh Engineers

1223 Mineral Spring Ave
North Providence, RI 02904
Phone: (401) 724-1771

Civil Engineer

Weston & Sampson, PE, LS, LA, PC

1 Winners Circle, Suite 130
Albany, NY 12205
Phone: (516) 463-4400

MEP Engineer

Barile Gallagher & Associates

Consulting Engineers
39 Marble Avenue, 2nd Floor
Pleasantville, NY 10570
Phone: (914) 328-6060

Acoustic Consultant

DP Design

12 Cold Spring Street
Providence, RI
401-861-3218

Environmental

**Quest Environmental Solutions &
Technologies, Inc.**

1376 Route 9
Wappingers Falls, NY 12590
845-298-6031

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SECTION 000115

LIST OF DRAWING SHEETS

1.1 LIST OF DRAWINGS

- A. Drawings: Drawings consist of the Contract Drawings and other drawings listed on the Table of Contents page of the separately bound drawing set titled Drawings Issued for BID, dated 07/23/2021.
- B. List of Drawings: Drawings consist of the following Contract Drawings and other drawings of type indicated:

T3-001 TITLE SHEET

CONSTRUCTION IMPLEMENTATION

CIP-01 CONSTRUCTION IMPLEMENTATION PLAN – GENERAL
NOTES & MILESTONE SCHEDULE

CIP-02 CONSTRUCTION IMPLEMENTATION PLAN – EXISTING
CONDITIONS & DEMOLITION PLAN

CIP-03 CONSTRUCTION IMPLEMENTATION PLAN – FIRST FLOOR &
ROOF PLANS

CIVIL

C3-100 EXISTING CONDITIONS AND DEMOLITION PLAN

C3-101 SITE PLAN

C3-102 GRADING AND EROSION AND SEDIMENT CONTROL PLAN

C3-103 UTILITY PLAN

C3-500 CONSTRUCTION DETAILS

C3-501 CONSTRUCTION DETAILS

C3-502 CONSTRUCTION DETAILS

C3-503 CONSTRUCTION DETAILS

C3-504 CONSTRUCTION DETAILS

ARCHITECTURAL

X3-101 FIRST FLOOR CODE COMPLIANCE PLAN

X3-102 FIRST FLOOR CODE COMPLIANCE PLAN

X3-110 ADDITION CODE COMPLIANCE & LIFE SAFETY PLAN

D3-101 FIRST FLOOR DEMOLITION PLAN

D3-120 ADDITION DEMO PLAN

D3-201 ADDITION DEMO ELEVATIONS

A3-101 FIRST FLOOR PLAN

A3-110 ROOF PLAN

A3-120 ADDITION FLOOR PLAN

A3-121 ADDITION POWER & TECHNOLOGY LEGEND

A3-122 ADDITION POWER & TECHNOLOGY PLAN

A3-130 ADDITION ROOF PLAN

A3-201 EXTERIOR ELEVATIONS - ADDITION

A3-202 EXTERIOR ELEVATIONS - ADDITION

A3-203 EXTERIOR ELEVATIONS - ADDITION

A3-204 EXTERIOR FIBER CEMENT PANEL DESIGN

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A3-211	INTERIOR ELEVATIONS - ADDITION
A3-212	INTERIOR ELEVATIONS - ADDITION
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A3-301	BUILDING SECTIONS - ADDITION
A3-302	BUILDING SECTIONS - ADDITION
A3-310	WALL SECTIONS - ADDITION
A3-311	WALL SECTIONS - ADDITION
A3-312	WALL SECTIONS - ADDITION
A3-320	WALL SECTION DETAILS - ADDITION
A3-321	WALL SECTION DETAILS - ADDITION
A3-322	WALL SECTION DETAILS - ADDITION
A3-330	ROOF DETAILS - ADDITION
A3-331	ROOF DETAILS - ADDITION
A3-332	ROOF DETAILS - ADDITION
A3-400	CEILING FIXTURE AND MATERIAL LEGENDS
A3-420	ADDITION REFLECTED CEILING PLAN
A3-430	ADDITION REFLECTED CEILING PLAN SOFFIT & FIXTURE DETAILS
A3-501	DIVISION OF CLASSROOM #36 DEMO AND FLOOR PLAN
A3-601	DOOR & FRAMING TYPES & SCHEDULES
A3-602	INTERIOR GLAZING TYPE & SCHEDULE
A3-603	EXTERIOR WINDOW TYPES
A3-604	EXTERIOR WINDOW AND DOOR SECTION DETAILS
A3-605	EXTERIOR WINDOW AND DOOR SECTION DETAILS
A3-606	EXTERIOR WINDOW AND DOOR SECTION DETAILS
A3-700	FINISH SCHEDULES & LEGENDS
A3-720	ADDITION FLOORING PATTERN
A3-721	ADDITION - WALL FINISH PLAN
A3-801	CASEWORK - WINDOW BENCH TYPE A
A3-802	CASEWORK - WINDOW BENCH TYPE B
A3-803	CASEWORK - WINDOW BENCH TYPE C
A3-804	CASEWORK - WINDOW BENCH TYPE D
A3-805	CASEWORK - WINDOW BENCH TYPE E
A3-806	CASEWORK - STUDENT CUBBIES
A3-807	CASEWORK - STUDENT CUBBIES
A3-808	CASEWORK - STUDENT CUBBIES
A3-809	CASEWORK - SINK BASE CABINET
A3-810	CASEWORK - TALL STORAGE WITH MOBILE CARTS A
A3-811	CASEWORK - TALL STORAGE WITH MOBILE CARTS B
A3-812	CASEWORK - CONFERENCE ROOM STORAGE
A3-813	CASEWORK - ADDITION LIBRARIES
A3-814	CASEWORK - ADDITION LIBRARIES
A3-815	CASEWORK - ADDITION LIBRARIES
A3-816	CASEWORK - ADDITION LIBRARIES
A3-817	CASEWORK - ADDITION LIBRARIES
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A3-901	FURNITURE SCHEDULE
A3-902	FURNITURE SCHEDULE
A3-903	FURNITURE SCHEDULE
A3-904	FURNITURE SCHEDULE
A3-905	FURNITURE SCHEDULE

A3-906	FURNITURE SCHEDULE
A3-907	FURNITURE SCHEDULE - 5th LEARNING STUDIO
A3-920	ADDITION FURNITURE PLAN

STRUCTURAL

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S3-001	LOADING AND DESIGN CRITERIA
S3-002	SCOPE OF WORK
S3-100	OVERALL FOUNDATION PLAN
S3-101	OVERALL ROOF FRAMING PLAN
S3-110	ADDITION FOUNDATION AND SLAB ON GRADE PLAN
S3-111	ADDITION ROOF FRAMING PLAN
S3-200	FRAMING ELEVATIONS
S3-201	FRAMING ELEVATIONS
S3-300	BUILDING SECTIONS
S3-400	TYPICAL FOUNDATION DETAILS
S3-401	TYPICAL FOUNDATION DETAILS
S3-500	TYPICAL STEEL DETAILS
S3-501	TYPICAL STEEL DETAILS
S3-600	TYPICAL MASONRY DETAILS
S3-800	COLUMN SCHEDULE

HEATING VENTILATION AND AIR CONDITIONING

H3-101	LEGEND, NOTES AND PARTIAL FLOOR PLAN
H3-201	ADDITION FIRST FLOOR PLAN
H3-202	ADDITION ROOF PLAN
H3-301	SCHEDULES
H3-401	DETAILS

PLUMBING

P3-201	LEGEND, SCHEDULE, NOTES AND FIRST FLOOR PART PLANS
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ELECTRICAL

E3-001	LEGENDS, ABBREVIATIONS AND NOTES
E3-101	ADDITION ELECTRICAL REMOVAL PLAN
E3-201	ELECTRICAL LIGHTING AND POWER PLAN
E3-501	ELECTRICAL RISER
E3-502	ELECTRICAL RISERS
E3-601	ELECTRICAL SCHEDULES
E3-701	ELECTRICAL DETAILS

AUDIO VISUAL

AVE3-001	AUDIOVISUAL KEYS, NOTES, AND SCHEDULES
AVE3-101	AUDIOVISUAL FIRST FLOOR PLAN - ADDITION
AVE3-111	AUDIOVISUAL FIRST FLOOR RCP - ADDITION
AVE3-201	HEARING LOOP SYSTEM LOOP WIRE LAYOUTS AND DIAGRAMS - ADDITION
AVE3-202	HEARING LOOP SYSTEM LOOP WIRE LAYOUTS AND DIAGRAMS - ADDITION
AVE3-511	AUDIOVISUAL FUNCTIONAL DIAGRAMS - ADDITION

END OF SECTION 000115

SECTION 021000

TREE PROTECTION AND TRIMMING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 WORK INCLUDED

- A. This section includes the protection and trimming of trees that are to remain but interfere with, or are affected by, execution of the Work, whether temporary or new construction.

1.3 RELATED SECTIONS

- Section 31 11 00: Clearing and Grubbing.
- Section 31 23 00: Earthwork.
- Section 31 23 16: Trenching, Backfilling and Compaction.
- Section 31 25 00: Sediment and Erosion Control.
- Section 32 91 13: Soil Preparation and Soil Mixes.
- Section 32 92 00: Lawns.

1.4 QUALITY ASSURANCE

- A. Tree Pruning Standards: Comply with the National Arborist Association's "Pruning Standards for Shade Trees" except where more stringent requirements are indicated.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Drainage Fill: Selected crushed stone, or crushed or uncrushed gravel, washed, ASTM D448, size 24, with 90 to 100 percent passing a 2½ inch (63-mm) sieve and not more than 10 percent passing a ¾ inch (19-mm) sieve.
- B. Topsoil: As per Specification Section 32 91 13: Soil Preparation and Soil Mixes.
- C. Filter Fabric: Manufacturer's standard, non-woven, pervious, geotextile fabric of polypropylene, nylon, or polyester fibers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Temporary Protection: Provide temporary fencing, barricades, or other suitable guards located outside the drip line (outer perimeter of branches) to protect remaining trees and other plants from damage.
- B. Protect tree root systems from damage due to noxious materials caused by run-off or spillage while mixing, placing, or storing construction materials. Protect root systems from flooding, eroding, or excessive wetting caused by dewatering operations.
- C. Do not store construction materials, debris, or excavated material within the drip line of remaining trees. Do not permit vehicles or foot traffic within the drip line, and prevent soil compaction over root systems.
- D. Do not allow fires.

3.2 EXCAVATION

- A. Install shoring or other protecting support systems to minimize sloping or benching of excavations.
- B. Do not excavate within tree drip line, unless otherwise indicated.
- C. Where excavation for new construction is required within tree drip lines, hand excavate to minimize damage to root systems. Use narrow-tine spading forks and comb soil to expose roots.
 - 1. Relocate roots in backfill areas wherever possible. If encountering large, main lateral roots, expose beyond excavation limits as required to bend and relocate without breaking. If encountered immediately adjacent to location of new construction and relocation is not practical, cut roots approximately 3 inches (75 mm) back from new construction.
 - 2. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition and temporarily support and protect roots from damage until they are permanently relocated and covered with earth.
- D. Where utilities trenches are required within tree drip lines, tunnel under or around the roots by drilling, auger boring, pipe jacking, or digging by hand.
 - 1. Root Pruning: Do not cut main lateral roots to tap roots; cut only smaller roots that interfere with installation of new work. Cut roots with sharp pruning instruments; do not break or chop.

3.3 REGRADING

- A. Grade Lowering: Where new finish grade is indicated below existing grade around

trees, slope grade beyond tree drip line. Maintain existing grades within tree drip lines.

1. Root Pruning: Prune tree roots exposed during grade lowering. Do not cut main lateral roots to tap roots; cut only smaller roots. Cut roots cleanly with sharp pruning instruments; do not break or chop.
- B. Minor Fill: Where existing grade is 6 inches (150 mm) or less below elevation of finish grade shown, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.
- C. Moderate Fill: Where existing grade is more than 6 inches (150 mm) but less than 12 inches (300 mm) below finish grade elevation, place a layer of drainage fill, filter fabric, and a final layer of topsoil on existing grade.
 1. Carefully place drainage fill against tree trunk approximately 2 inches (50 mm) above finish grade elevation and extend not less than 18 inches (450 mm) from tree trunk on all sides. For balance of area within drip line perimeter, place drainage fill to an elevation 6 inches (150 mm) below grade.
 2. Place filter fabric with overlapping edges of 6 inches (150 mm) minimum.
 3. Place fill layer of topsoil to finish grade. Do not compact drainage fill or topsoil. Hand grade to required finish elevations.

3.4 TREE PRUNING

- A. If required, prune remaining trees to compensate for root loss caused by damaging or cutting root system as directed by the Landscape Architect in accordance with accepted horticultural practices.
- B. Cut branches with sharp pruning instruments; do not break or chop.

3.5 TREE REPAIR AND REPLACEMENT

- A. Promptly repair trees damaged by construction operations to prevent progressive deterioration.
 1. Provide new trees of size and species selected by the Landscape Architect when trees over 6 inches (150 mm) in caliper, measured 12 inches (300 mm) above grade, are required to be replaced, due to abuse/damage/neglect of contractor.

3.6 DISPOSAL OF WASTE MATERIALS

- A. Burning on Owner's Property: Burning is not permitted on Owner's property.
- B. Disposal: Remove excess excavated material, displaced trees, and excess chips from Owner's property.

END OF SECTION 021000

SECTION 022113

SITE SURVEY

PART 1 - GENERAL

1.1 **RELATED DOCUMENTS:** Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Layout for all site work performed by a licensed surveyor.
2. Maintaining site control.
3. Preparing record drawings showing all new utilities and building additions.
4. Locate property and/or easement lines, building or other facilities that could affect construction.

1.3 DEFINITIONS

A. **Licensed Surveyor:** Registered in state where project is located and accepted by the Owner's Representative.

1.4 SUBMITTALS

- A. Copies of the following will be made available to the Owner's Representative upon request throughout the project. Give the original to the Owner for his permanent files no later than two weeks after Contract completion.
1. Establish, maintain, and have available for review by the Owner's representative, throughout term of Contract, legible, comprehensive and complete survey notes, computations, sketches, drawings and similar records kept in a conventional format that is acceptable to the Owner's representative.
 2. Record Plans or As Builts of all site improvements performed under this Contract. Using the same design system(s), the level accuracy of Record Plans or As Builts will be equal to that intended on design plans. All data on design plans will be verified or changed to reflect As Built conditions.
 3. All calculations and field notes required to reestablish or modify the original control.

1.5 QUALITY ASSURANCE

A. All survey calculations of field work, where the accuracy could affect construction or the original design intent, shall be performed under the supervision of a Surveyor licensed in the state of the project. If requested by the Owner's representative, the Contractor shall have the portion of survey in question certified that the work was done under the supervision of a licensed Surveyor in the

applicable state.

- B. Perform survey work in accordance with recognized professional surveying practices, complying with local and state laws, rules and regulations. Ensure work performed by qualified personnel acceptable to Owner's representative.
- C. Maintain Project Survey field work in a condition such that it can be checked by the Owner's representative, and provide assistance in carrying out these checks. Checking by the Owner's representative does not relieve the responsibilities of this Contract.

1.6 PROJECT CONDITIONS

- A. No protected areas, site improvements, off-site areas or any areas to remain will be permanently marked or damaged without written consent of the Owner's representative.
- B. All stake-out placed for installation of or performance of site improvements will be maintained in a manner to allow the Owner's representative to perform construction observation.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Surveying instruments and equipment used in performing the Project Survey shall be of the type(s) appropriate for the application at hand and shall be kept in acceptable calibration and good working order.

2.2 MATERIALS

- A. All temporary materials used in field shall be weather resistant and of standard quality.
- B. All permanent materials incorporated into the project shall be a type that prevents movement from freeze-thaw, minor contact or other expected occurrences and is found to be acceptable by the Owner's representative and local or state authority. When possible, use material specified on the Drawings.

PART 3 - EXECUTION

3.1 FIELD

- A. All survey layout work shall be tied or referenced to the control survey data shown on the plans or supplied by the Engineer. The existing control shall be maintained in its original condition throughout the term of the Contract. If alteration of the original baseline condition is unavoidable, notify the Engineer of this situation and present a plan and procedure to the Engineer for review to remedy this alteration. Bring any error, apparent discrepancy in or absence of control survey data provided, to the Owner's representative's attention for resolution.

- B. At the direction of the Owner, establish, stake and reference all rights-of-way, easement limits, and building corners, and where required, stake under the direction of a licensed Land Surveyor. The licensed Land Surveyor shall, through the Contractor, present to the Engineer a certificate with the professional's seal in an acceptable format that such information has been accomplished under his or her direction.
- C. At all times maintain the project survey field work in a condition such that it can be reviewed by the Engineer, and render reasonable assistance to the Engineer in carrying out such checks. However, reviewing by the Engineer does not relieve the Contractor of his responsibilities under this Item.
- D. Assume sole responsibility for obtaining right of entry to properties, other than those properties on which the Owner has obtained easements with surface rights, for the purpose of conducting layout and survey work.

3.2 RECORD DRAWINGS/AS BUILT DRAWINGS

- A. Upon completion of the work under this Item, present a certificate to the Engineer attached to the As-built drawings, stating that all of the facilities shown on the Drawings or as may be added, deleted, or altered upon review of the Engineer, have been located in accordance with such Drawings or approved modifications thereof.

END OF SECTION 022113

SECTION 023200
GEOTECHNICAL INVESTIGATIONS

FINAL REPORT

GEOTECHNICAL INVESTIGATION AND FOUNDATION RECOMMENDATIONS

**MIDLAND ELEMENTARY
SCHOOL
312 MIDLAND AVENUE,
RYE, NY**

Prepared for:

Ms. Gabrielle O'Connor
Asst. Superintendent for Business
Rye City School District
555 Theodore Fremd Ave, Suite B 101
Rye, NY 10580

May 7, 2020

Prepared By:

Geotechnical Engineering Services, P.C.
6 Bayberry Road
Elmsford, New York 10523



May 08, 2020

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1.1 GENERAL

As described by our geotechnical proposal, dated March 17, 2020, this report presents the results of a subsurface investigation and geotechnical recommendations for the proposed construction at Midland Elementary School, in Rye, New York. The objectives for this investigation were to determine the in-situ subsurface conditions at the site, as well as provide foundation design and construction-related recommendations for the proposed one-to-two-story addition.

1.2 PROJECT LOCATION, DESCRIPTION, GEOLOGY AND SITE HISTORY

The proposed one-to-two story addition is located at the southern end of the existing one-story Midland Elementary School at 312 Midland Avenue (County Route 72) in Rye, New York. The proposed footprint of the addition is currently occupied by an asphalt play area at the north end and lawn for the remainder of the proposed footprint. The proposed addition is bordered by lawn and Midland Avenue further to the west, the existing Midland Elementary School to the north, a children's playground and modular classrooms to the east, a two-story single-family residence and rear yards at 1 Platt Lane to the south. According to the proposed boring location plan provided to us, it appears that the proposed square footage of the new addition is about 7,072-square-feet in footprint area. No new cellar levels are planned at this time. No New York City Transit Authority (TA) rail lines are within 200 feet of the proposed addition.

Geotechnical Engineering Services, P.C. (GES) did not perform any surveying and solely relied on information as measured in the field, as well as a December 18, 2019 First Floor Plan Phase 2, by Geddis Architects, provided by Mr. Robert J. Firneis of Savin Engineers, P.C. This plan did not include a Property Line Survey, nor were we provided with one. Therefore, no elevations have been provided in this report, and all depths referenced in this report are measured from surrounding grade, unless otherwise noted. The existing grade within the proposed new addition footprint generally slopes downward to the south and west, starting from the first-floor slab level of the existing one-story school building.

The exact bottom of excavation is unknown to us at this time. We understand that the final foundation design has not been completed yet. We request that should the proposed construction be modified in such a way that deviates from our recommendations noted herein, that we be given an opportunity to revise our geotechnical recommendations.

Site History and Geology

Based on a review of historic maps, aerial photographs, and geologic maps for this area, it appears that the school was constructed prior to our earliest aerial photograph, dated 1954, with the original footprint located further to the north. The adjacent portion of the school building to the north was constructed between 2004 and 2006, with no layout changes since 2006. Prior to construction, the site of the school was occupied by an empty grass field. No previous structures appear to have occupied the site of the planned extension.

According to Isachsen and Fisher's "Geologic Map of New York" (1970), the bedrock at the site maps as Harrison Gneiss, which is characterized by biotite-hornblende-quartz-plagioclase gneiss, with accessory garnet and sphene. This area is located well north of the terminal moraine, of the last advance of glacial ice in this region.

1.3 OBJECTIVES AND SCOPE OF SERVICES

The objectives of this investigation were to evaluate the subsurface conditions beneath the footprint of the proposed addition, and to provide geotechnical and construction-related recommendations. The following scope of services was performed:

1. Performed three (3) geotechnical borings approximately where shown on the proposed boring and test pit location plan, provided to us, and shown on the attached Boring and Test Pit Location Plan on Drawing No. B-100.00 in Figure 1.
2. Performed one (1) exploratory test pit at the site, as shown in the sketch in Appendix B.
3. Provided full-time controlled inspection of the drilling and test pit excavation operations.
4. Prepared this report that includes the following:
 - a) Description of the methodology of drilling and sampling, and test pit excavation, with respect to the proposed construction;
 - b) A Boring and Test Pit Location Plan showing the as-drilled/excavated locations of the borings and test pit, respectively;
 - c) Results of engineering evaluations and recommendations regarding the foundation design including:
 - Foundation type and estimated allowable bearing pressure;
 - Geotechnical earthquake engineering considerations including site classification and liquefaction evaluation;
 - Permanent and temporary groundwater control measures;
 - Support of excavation, underpinning, and lateral earth pressure considerations;
 - First floor slab-on-grade and new footing subgrade preparation;
 - Compaction control, excavation, and backfilling;
 - Construction monitoring considerations including optical and vibration monitoring, including protection of the existing school building, nearby utilities, and surrounding lawns.
 - d) List of Figures, which includes the Boring and Test Pit Location Plan and a plot of ambient groundwater levels at the site, and falling head testing, performed within the monitoring well.
 - e) Appendices A through D, which include geotechnical boring logs, a hand-drawn sketch of the test pit, a test pit photographic log, and laboratory test data.

2.1 GENERAL

Our subsurface investigation consisted of field locating and drilling three (3) geotechnical borings and excavating one (1) exploratory test pit, as shown on our attached Boring and Test Pit Location Plan. Typed boring logs are attached to this report as Appendix A. The hand-drawn test pit sketch and a test pit photographic log of Test Pit TP-1, are also available in Appendices B and C, respectively. Laboratory test data for select samples from the borings are available in Appendix D. The details of the subsurface investigation program and the generalized subsurface conditions, and information regarding the existing building foundation are described below.

2.2 GEOTECHNICAL BORINGS

Three (3) geotechnical borings, denoted as B-1, B-2, and B-3 were performed by Municipal Testing Laboratory, Inc. (MTL) of Hauppauge, New York, using a small Fordia Track-Mounted Drill Rig, from April 2 to 6, 2020, as shown on the Boring and Test Pit Location Plan on Figure 1. The borings were continuously inspected by Messrs. Aflaaz Saleem, Ahmed Obidat, and Michael Torino, P.E. of GES. In accordance with the RFP, Borings B-1 and B-3 were grouted upon completion.

The borings were drilled utilizing the mud-rotary drilling technique with a 3-7/8-inch diameter tri-cone roller bit and 4-inch diameter steel casing to stabilize the boring. Soil samples were obtained using techniques and equipment in general accordance with the American Society for Testing and Materials (ASTM) Standard Specification D1586-Standard Penetration Test (SPT). The SPT consists of driving a 2-inch O.D. split-spoon sampler typically to 24 inches of penetration, using repeated blows of a 140-lb hammer, free-falling a height of 30-inches. The standard penetration value, or N-value, is determined as the number of blows required to advance the sampler the sum of the second and third 6-inch intervals of a typical 24-inch penetration.

The hammer used was an automatic trip hammer. This hammer operates with an efficiency of about 90% whereas the manual (cathead and rope) hammer operates at an efficiency of about 60%. This means that the blow counts that are reported on the boring logs, where the automatic hammer was used, are about 2/3 of the values that would be reported if a conventional donut-type hammer had been used. A correction factor of 1.3 is generally used to convert the N-values from the automatic hammer to the normalized N-value (N_{60}).

Where the split-spoon sampler could not be advanced through rock or an obstruction, the sampler was driven for 50 blows, and distance of actual penetration less than 6 inches was recorded. Soil samples were placed in jars following completion of sampler advance and brought to Terrasense in Totowa, NJ for testing and confirmation of sample classifications. Boring logs showing N-Values and stratigraphy are attached as Appendix A. The recovered split-spoon soil samples were labeled with the project name, boring number, sample number, depth of sample, SPT blow counts and length of recovery.

All borings were drilled within or within 25 feet of the footprint of the proposed addition. MTL pre-cleared all boring locations for utilities, using a post-hole digger in the uppermost four (4) feet. Once cleared for utilities, SPT split-spoon soil sampling was generally performed continuously to 12 or 20 feet, then on five-foot centers to the completion depth of the borings, or top of rock, whichever is shallower.

- Boring B-1 was drilled at the northeastern corner of the proposed new addition to a depth of 22 feet. No bedrock was encountered in Boring B-1.
- Boring B-2 was drilled at the southwestern corner of the proposed new addition to a depth of about 20 feet. No bedrock was encountered in Boring B-2. A PVC groundwater monitoring well was installed, with 10 feet each of PVC slotted screen and riser, to ground surface.
- Boring B-3 was drilled at the southeastern corner of the proposed new addition to a depth of about 26 feet, encountering decomposed rock at a depth of about 17.5 feet. No rock coring was performed in Boring B-3.

2.3 LABORATORY TESTING

Upon completion of the geotechnical investigation, laboratory testing was assigned and performed, which includes determination of water content, Atterberg Limits, Sieve Analysis, as well as reclassification and verification of sample descriptions. Laboratory testing was performed at TerraSense Laboratory in Totowa, New Jersey. All laboratory test results are presented in Appendix D.

- ***Water Content (ASTM D2216):*** Natural water contents were obtained for select samples, and are reported on the boring logs, as well as attached to this report. The water content assists in sample classification and in establishing useful relationships with other soil parameters.
- ***Atterberg Limits (ASTM D4318):*** The Atterberg Limits are index tests that aid in soil classification and in establishing relationships with other soil parameters. Atterberg Limits were determined for select cohesive samples.
- ***Sieve Analysis (ASTM D422):*** A Sieve Analysis is a quantitative determination of the distribution of particle sizes within soils. Granular portions of the soil are retained on sieves after mechanical shaking, while the fines content is determined by the amount remaining on the #200 Sieve.

2.4 TEST PIT AND DESCRIPTION

One (1) exploratory test pit, denoted as TP-1, was performed where shown on the Boring and Test Pit Location Plan in Figure 1. The location of Test Pit TP-1 was selected by others. TP-1 was excavated, backfilled, and compacted by MTL, using hand-tools, on April 2, 2020, under continuous inspection by Mr. Haykel Melaouhia, Ph. D. of GES. Upon encountering the bottom of foundation, GES photographed, logged, and measured the test pit. The test pit was excavated and backfilled with the excavated soil in lifts, and compacted using a hand tamper. In accordance with the RFP, MTL removed all excavated material from the site, and replaced the grass using seeds at grade. No groundwater or bedrock were encountered.

Detailed descriptions of the test pit excavation are presented below. All depths are relative to top of surrounding grade. The test pit sketch is attached as Appendix B, and a photographic log is attached as Appendix C:

- **Test Pit TP-1** (*3-feet-wide x 3-feet-long x 5.9-feet deep*) was excavated three (3) feet west of the southeast corner of the adjacent school building's existing addition. Subsurface conditions consist of about 1.3 feet of uncontrolled fill, consisting of brown silty coarse to fine sand, with some brick fragments, gravel, and cobbles. Underlying the fill and the foundation at this location, GES encountered natural tan and brown silty coarse to fine sand, with some gravel and cobbles.

The test pit revealed that the existing addition at the north side of the test pit is composed of a brick wall above ground, extending down by about 0.6 feet, above a concrete strip footing for a concrete foundation wall. The strip footing, juts to the south by about 0.8 feet and is 1.3 feet thick. A portion of the wall also juts out to the south by about 0.5 feet, and is 0.4 feet thick, at about 0.6 feet below grade. The bottom of the existing footing was found at about 5.7 feet below grade. GES attempted to probe laterally under the footing, but was unable to find the width of the footing due to the depth, cobbles under the footing, and possible perched water, which was encountered at a depth of about 5 feet below grade.

2.5 GENERALIZED SUBSURFACE CONDITIONS

The following general descriptions of the subsurface strata are based on our interpretations of the results of the field investigation. All depths are relative to surrounding grade, which was grass at grade. Blow counts have not been corrected for the use of the automatic hammer. As noted above, a hand-auger was used in the uppermost four (4) feet to pre-clear each hole for utilities:

Stratum 1: Fill – The Fill generally consists of brown, dark brown, and black medium to fine sand, with varying amounts of gravel, silt, and asphalt fragments. The fill layer was found in all borings, extending from 1.5 to 5.5 feet below grade, shallower at Borings B-2 and B-3, further away from the existing school building. One SPT split-spoon was taken within the fill, which had an N-Value of 17 blows per foot (bpf). Additional N-Values are unavailable due to the use of the hand-auger.

Stratum 2: Loose Sand – Encountered below Stratum 1 in Borings B-2 and B-3 only, and the test pit, this stratum consists of loose brown coarse to fine sand with varying amounts of gravel, silt, and clay. Stratum 2 was likely replaced by Fill during construction of the school building at Boring B-1. Stratum 2 was measured to range in thickness from 4 to 5 feet, and extend to depths ranging from 6 to 6.5 feet. SPT N-Values for Stratum 2 ranged from 7 to 10 bpf with an average of 8 bpf, indicative of loose sand, though only three (3) SPT split-spoons were taken within Stratum 2.

Stratum 3: Sand with Clay – Encountered below Stratum 2 in Borings B-2 and B-3, and below the Fill in Boring B-1, Stratum 3 generally consists of loose to medium dense gray and brown coarse to fine sand and silt with some clay and varying amounts of gravel. Stratum 3 was measured to be between about 3 and 4.5 feet thick, and extend as deep as 9 to 10 feet below surrounding grade. SPT N-Values for this stratum ranged from 4 to 27 bpf, with an average of 17 bpf.

Stratum 4: Loose to Medium Dense Sand – Encountered below Stratum 3 in all borings to the completion depth of Borings B-1 and B-2, this stratum generally consists of loose to dense red brown and brown coarse to fine sand, with varying amounts of gravel and silt. Stratum 4 was found to range in thickness from 8.5 feet in Boring B-3 to at least 12 feet in Boring B-1. Stratum 4 extends to a depth from about 17.5 feet to at least 22 feet in Borings B-3 and B-1, respectively. SPT N-Values for this stratum ranged from 6 to 55 bpf, with an average of 24 bpf.

Stratum 5: Decomposed Rock – Stratum 5 was found in Boring B-3 only, where the samples show Stratum 5 contains very dense gray decomposed rock fragments. Boring B-3 was terminated in Stratum 5 after extending from 17.5 to 26 feet depth (8.5 feet thick). Three-quarters of all SPT N-Values within Stratum 5 encountered refusal, with one (1) SPT N-Value of 54 bpf, where refusal was not encountered.

2.6 GROUNDWATER CONDITIONS

Following completion of Boring B-2, MTL installed a 20-foot-deep groundwater observation well on April 7, 2020 in the completed borehole, consisting of ten (10) feet of PVC slotted screen and ten (10) feet of riser surrounded by filter sand. Groundwater readings were taken manually on April 6, 16, and 23, 2020, using an electronic water level indicator. An electronic piezometer was also installed to take hourly readings of the water levels from April 6 to 23, 2020.

As shown in the attached plot of Groundwater levels in Figure 2, and based on the manual and electronic readings, the groundwater level was fairly consistent and ranged from about 5.5 to 6.5 feet depth at Boring B-2. Percolation testing was also performed, as discussed below.

With consideration of the data collected, and our analysis of the results, we therefore recommend a design groundwater level of 3.5 ft below grade at Boring B-1. We would also recommend that a property line survey be performed, so that a design groundwater elevation can be provided, to ensure accuracy of the recommendation.

Please note that changes in groundwater levels may occur due to variations in seasonal influences, precipitation amounts, local pumping, utility leakage, and other factors different from those existing at the time the observations were made.

2.7 PERCOLATION TESTING

Our methodology was to perform two (2) falling head tests within the monitoring well, in order to show the infiltration rate of groundwater from the monitoring well, into the surrounding soil. All percolation testing discussed below is in terms of depth below surrounding grade, and is at the location of Boring B-2, at the southwest corner of the proposed new addition. The plots of the falling head tests performed can be found in Figure 3, and is discussed herein.

Methodology

After installation of the groundwater monitoring well in Boring B-2 (“the well”) on April 3, 2020, the well was flushed to disperse any drill fluid from the perimeter of the drill hole. Mr. Michael Torino, P.E. of GES returned to the site on April 16, 2020, and took an initial water level reading of 6.2 feet depth below grade. GES then filled the well to surrounding ground level with water, to pre-soak the soil surrounding the piezometer, prior to percolation testing. GES then timed the drop of head of water within the well, at incremental readings from 10 seconds to 5 minutes until the head of water in the well reached the initial water level, i.e. for about 19 to 25 minutes. This falling head test was repeated once more following the initial test, for redundancy in results. Please see Figure 3 for a plot of our testing.

Results and Analysis

Based on the proposed scope of a one-to-two-story addition, no proposed cellar levels, the subsurface soils encountered, and the depth at which groundwater was encountered, it appears

unlikely that groundwater would be encountered during construction, if foundations are kept above the level at which groundwater was observed.

If the project also entails the placement of planters, trees, or shrubs which may depend on freely draining soil and deeper groundwater, it may be beneficial to have this data. Dry-wells, also if required for this project, will also heavily rely upon the ability for the soil to disperse stormwater. We have not been asked to provide a design for a dry-well, but can submit a separate proposal to provide special inspection of a dry-well, if required for this project, upon the client's request. The soil appears to be fairly permeable and permit free draining or recharge of surface or groundwater.

Please see our recommendations in Section 3.5 and 4.2 concerning permanent and temporary control of stormwater and protection from water infiltration into the concrete.

3.1 GENERAL

This section of the report presents seismic considerations, our recommendations for feasible foundation and floor slab systems, lateral earth pressures, and permanent control of groundwater. Our evaluation and recommendations are based on the subsurface conditions encountered at the boring locations, our understanding of the site geology, foundation loading information, and construction considerations.

3.2 SEISMIC CONSIDERATIONS

The subsurface soils at the site below the water table, within 26 feet of ground surface generally consist of loose sand, overlying sand with clay, over loose to medium dense sand, over decomposed rock. Based on the results of our geotechnical investigation, we recommend a Site Class of “D” for this site. With consideration of the medium dense nature of much of the soil encountered, any areas that have the slight potential to liquefy are expected to be localized in nature, and therefore liquefaction is not a concern at this site.

3.3 FOUNDATION RECOMMENDATIONS

As noted above, we understand that you plan to construct an about 7,072-square-foot, one-to-two-story addition, onto the south side of the existing Midland Elementary School. We understand the proposed addition will not have any cellar levels. Our test pit (TP-1) revealed the bottom of the south side of the existing school building is founded at about 5.7 feet below grade. We therefore recommend that the proposed addition can be founded on shallow foundations, matching or stepping away from the adjacent foundation (which should be on a 1.5H:1V, as to not impose any loads on the existing foundation). Placement of the new footings at this level should prevent the need or any underpinning of the existing foundation. Any new footings also should bear below the minimum required depth to be below the frost line in this area. Based on the soil encountered, groundwater level, and expected loading of the addition, we recommend that the footings can be designed to bear on Stratum 1 or 2, with a maximum allowable bearing pressure of 1 ton per square foot (tsf), provided the subgrade for any new footings is proof-rolled with a minimum of six (6) overlapping passes of a vibratory roller, or as otherwise approved by the Engineer.

We also recommend that the new footings consider the effects of uplift pressure imposed by groundwater at the design groundwater level of 3.5 feet below existing grade, at the location of Boring B-2.

The fill used as bearing material must be free of voids, and extensive inclusions of mud and organic materials, such as paper, wood, garbage, cans, or metallic objects and debris. It is anticipated that settlement under the building loads is expected to be on the order of ½ inch, though most of the settlement is expected to occur during construction. A minimum of 6 inches of ¾-inch crushed stone should be placed under the footings and slab-on-grade and compacted. The recommended bearing pressure is also dependent on GES being retained to provide controlled inspection of the subgrade.

Prior to construction of the footings, the subgrade of the spread footings shall be inspected by a NYS-licensed geotechnical engineer, familiar with the soil conditions. Should the soil at the design subgrade elevation be found to be unsuitable for further construction, softer and wetter areas may

need to be removed and replaced by $\frac{3}{4}$ -inch clean crushed stone and compacted in maximum 12-inch-thick lifts.

3.4 LATERAL EARTH PRESSURES

The design lateral pressures for permanent below grade foundation elements consist of static pressures that are influenced by the thickness and type of overburden material. For design purposes, we recommend that the below grade foundation elements above the design groundwater level be designed for a static lateral soil pressure of 45 pcf, and that the walls/footings below the design groundwater level be designed for a static lateral soil pressure of 85 pcf.

The New York State Building Code also requires that the below grade foundation elements be designed to resist seismic loads. We recommend using a seismic lateral soil force of $6H^2$ (lb/ft of foundation element), where H is the total vertical height in feet. This force is in addition to the static force, applied at a distance of H/3 from the top of the foundation element (pressure is an inverted triangle).

The recommended lateral pressure does not include any surcharge loads adjacent to the walls or at the ground surface. We recommend adding a uniform (i.e., rectangular) lateral pressure distribution of 0.40 times the surcharge to the lateral soil pressure distribution. The structural engineer should determine the magnitude of the surcharge loads (i.e., live loads), based on the final design of the surrounding area.

3.5 PERMANENT GROUNDWATER CONTROL

Our groundwater monitoring well in Boring B-1 showed that groundwater was encountered between 5.5 and 6.5 feet below grade. No cellar levels are planned for the proposed new addition. Therefore, it is unlikely that groundwater would be encountered while constructing the proposed addition. However, we recommend that a vapor barrier be placed below any subsurface foundation element to prevent intrusion of moisture into the concrete. The material used for the vapor barrier should be submitted to the geotechnical engineer for review and approval. We recommend that the vapor barrier be inspected by a controlled inspector, or installed by a certified installer.

We also recommend that the permanent groundwater control measures be revisited after final foundation design, to confirm no waterproofing is required.

4.1 GENERAL

The following sections provide recommendations regarding temporary surface water control during foundation construction, temporary support of excavation and underpinning, preparation of the subgrade for shallow foundations / slab-on-grade, excavation considerations, backfill and compaction control, pre- and post-construction surveys of the existing building or utilities, construction monitoring, and geotechnical engineer inspection requirements.

4.2 TEMPORARY GROUNDWATER CONTROL

Groundwater was encountered within 5.5 to 6.5 feet of the existing ground level at the location of Boring B-2. Since the bottom of the new footings will likely be constructed between about four (4) feet and the bottom of the existing foundation for the adjacent existing addition, i.e., 5.7 feet below existing grade, a temporary groundwater control system will not likely be required. We recommend that any surface water from rain events, or other reasons be disposed of by the use of sump pumps. All foundation subgrades, which include slabs-on-grade and new footing subgrades should be protected from rain events before the placement of concrete. All concrete placement should be performed in the dry and maintain dry working conditions during foundation construction.

4.3 TEMPORARY SUPPORT OF EXCAVATION AND UNDERPINNING

It is our understanding that the proposed new building will not have a basement level, and the new building's foundations will not likely extend any deeper than about four (4) feet, to ensure the foundation for the new one-story building will bear below the frost line, or possibly slightly deeper to match the bottom of foundation level for the existing school building at 5.7 feet depth. We recommended above in Section 3.3, that the new footings should be constructed at the same depth as the existing footings, or stepping away to prevent imposing lateral loads on the existing foundation and the need for underpinning, on a 1.5H:1V slope or flatter.

We recommend that the excavation for any new footings/grade beams or trenches for utilities can be supported by using timber sheeted pits, with wood lagging and bracing. Deeper utilities could require the design and installation of a support of excavation system, which can be addressed once the final design requirements for utilities have been determined. The design of any temporary excavation support system should be the responsibility of a highly experienced, licensed New York State Professional Engineer. All excavations of temporary support systems should conform to pertinent OSHA and local safety regulations. The soil parameters used in the design of the temporary support system should be reviewed by the geotechnical engineer prior to construction of the support structures. Excavations and bracing are subject to controlled inspection.

An alternative to sheeted pits is the use of sloping or benching excavations to the design subgrade level. We recommend that any slopes be carefully graded using a flat-plated excavator bucket to a slope no steeper than 1.5H to 1V. Benching of excavations should also be performed using a flat-plated bucket, with a maximum step height of two feet, and minimum bench width of three feet.

4.4 SUBGRADE PREPARATION

In order to limit differential settlement of the first-floor slab-on-grade and footings, we recommend that the soil subgrade be proof-rolled with a minimum of six (6) passes of a vibratory plate tamper,

or other approved equipment. Any unstable areas encountered which cannot be stabilized by additional compaction should be excavated to competent material and the area backfilled with compacted select or structural backfill. The proof-rolling should not be performed when the subgrade is wet, muddy, or frozen. If the footings/slab-on-grade are constructed in the winter, the subgrade should be protected from frost action to limit possible subgrade deterioration resulting from freezing and thawing cycles. Subgrade preparation and inspection are subject to controlled inspection.

4.5 EXCAVATION CONSIDERATIONS

As stated above, the proposed new building will not have any cellar levels. We recommend that excavation for the new building footings be performed using a flat-plated excavator bucket. This would also include sloping of any excavations, which must not be steeper than a 1.5H to 1V envelope as noted above. Final cut for the subgrade for new footings or slabs must either be performed by hand, i.e. shovels, or using the flat-plated bucket attached to an excavator. Any over-excavated areas for footing subgrade disturbed by construction or excavation activities must be completely removed and replaced with select backfill or crushed stone and compacted. Excavation shall not penetrate a 1.5H:1V envelope below the bottom of any nearby foundation element/utility, so as to not undermine the bearing material. We recommend that excavation and grading be performed under the continuous inspection of a geotechnical engineer.

Temporary support of excavation systems must follow recommendations as outlined in Section 4.3 above. The design of such system is the responsibility of the contractor and must adhere to all relevant codes and acceptable industry standards and practices.

4.6 BACKFILL AND COMPACTION REQUIREMENTS

Where needed, select backfill or structural backfill should be granular material only, free of cinder, brick, asphalt, ash, silt/clay, and other unsuitable materials. We recommend that structural backfill or select backfill beneath slabs-on-grade be compacted to a minimum of 95% of the maximum dry density, as determined by ASTM D1557, Method C. All backfill should be placed in lifts not exceeding 8 inches in loose thickness. All crushed stone should be placed in lifts not exceeding 12 inches in loose thickness. The subgrade underneath the backfill should be satisfactorily proof-rolled prior to placement of backfill and should also meet the same density requirements as the backfill to be placed above the subgrade. All fill placement shall be subject to special inspection.

4.7 PRE-CONSTRUCTION SURVEY AND MONITORING

A pre-construction survey should be performed for any structure/utility within 25 feet of the construction site. We recommend a monitoring plan be assembled by an experienced Professional Engineer. At a minimum, the plan should include the existing school building and the surveyed locations and elevations of any nearby utilities within 25 feet of the site, to ensure they are protected and supported throughout construction. We recommend these utilities be monitored on a routine basis, as determined by the geotechnical engineer assembling the plan, to ensure no settlement/movement occurs.

At this time, we recommend that the maximum peak particle velocity (PPV) readings be kept below 1 in/sec for the school building or any nearby utility, as measured by seismographs. Additionally, we recommend that the maximum permissible vertical and horizontal movement of

the school building be limited to ½ inch, as measured by optical prism points on the existing school building. These levels may be further lowered depending on the condition of this building, and based on the pre-construction survey. We also recommend that all portions of the building within 25 feet of the site be monitored for cracks or damage on a routine basis, to ensure no damage occurs to the existing school building.

4.8 CONSTRUCTION INSPECTION

Our recommendations are contingent upon the proper review and observation during excavation and foundation construction operations by a geotechnical engineer familiar with the subsurface conditions and foundation design criteria. The geotechnical engineer's role should include the following:

- Review and approval of contractor submittals related to foundation construction;
- Observation and documentation of all phases of excavation and foundation construction;
- Controlled inspection of subgrade preparation;
- Monitoring of subgrade preparation and structural fill placement and compaction.

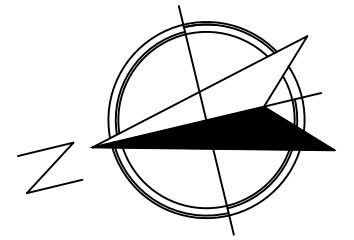
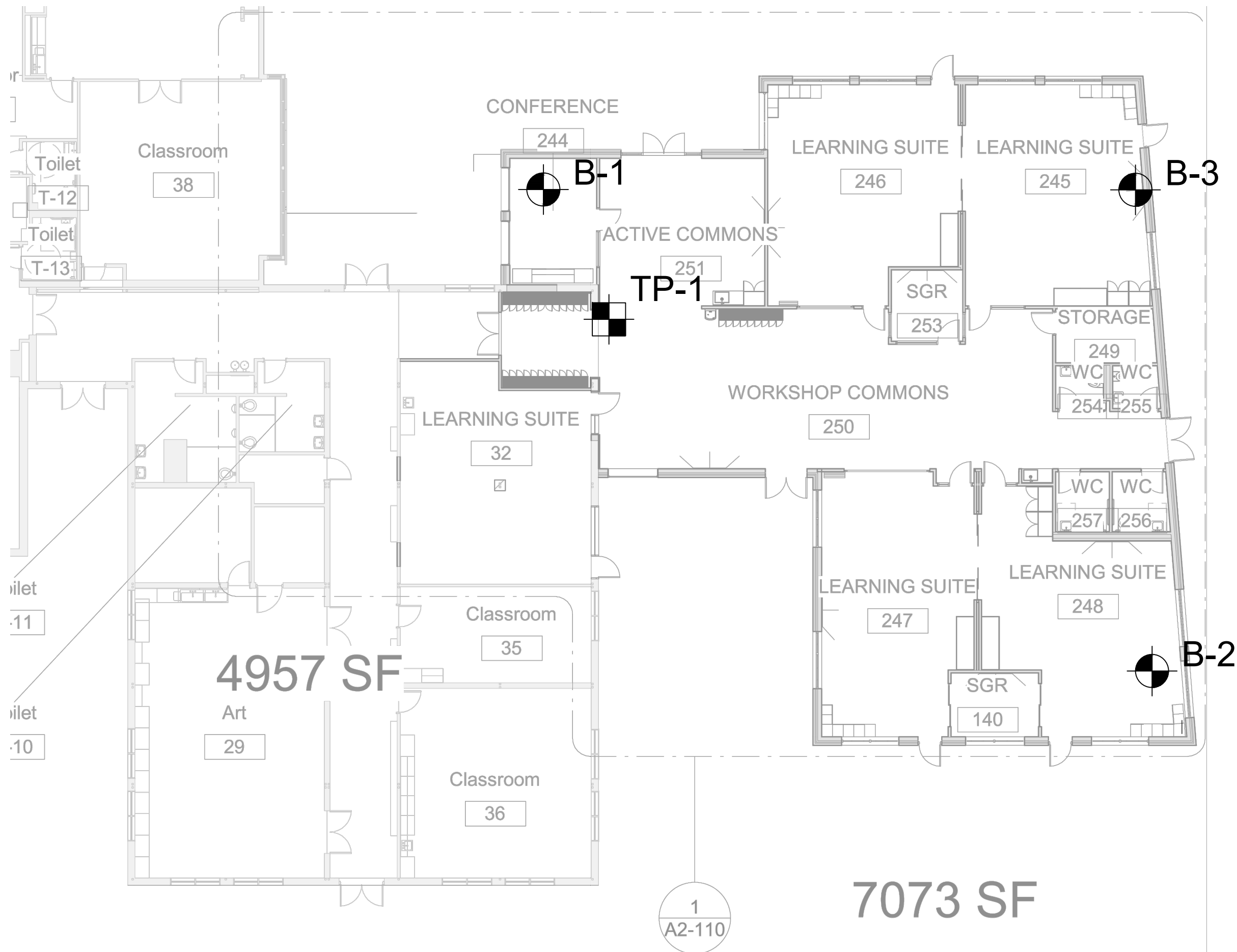
Our conclusions and summary of recommendations are as follows:

1. Based on the results of our geotechnical investigation, we recommend a Site Class of “D” for this site. With consideration of the medium dense nature of much of the sand encountered at the site, any areas that have the slight potential to liquefy are expected to be localized in nature, and therefore liquefaction is not a concern at this site.
2. We recommend that the proposed new building can be supported by shallow footings bearing on Stratum 1 or 2, with a maximum allowable bearing pressure not exceeding 1 tsf. The fill used as bearing material must be free of voids, and extensive inclusions of mud and organic materials, such as paper, wood, garbage, cans, or metallic objects and debris, provided the subgrade for any new footings is proof-rolled with a minimum of six (6) overlapping passes of a vibratory roller, or as otherwise approved by the geotechnical engineer. Prior to construction of the footings, the subgrade of the spread footings shall be inspected by a NYS-licensed geotechnical engineer, familiar with the soil conditions.
3. Groundwater was measured to be between about 5.5 to 6.5 feet at the location of Boring B-2. A design groundwater level of 3.5 feet below grade was recommended for foundation design. Permanent groundwater control measures will likely not be required. We recommend that a vapor barrier be placed below any subsurface foundation element to prevent intrusion of moisture into the concrete, with recommendations to be revisited after final foundation design.
4. We recommend the contractor be prepared to control any runoff water by the use of sump pumps or other suitable means. The subgrade for any new footing or slab must also be protected from rainwater or runoff, to prevent undermining the approved subgrade.
5. We recommend that the excavation for any new footings or trenches for utilities be supported by using timber sheeted pits, with wood lagging and bracing. The design of any temporary excavation support system should be the responsibility of a highly experienced and licensed New York State Professional Engineer. Another alternative to sheeted pits is the use of sloping or benching excavations to the design subgrade level at a no steeper than 1.5H to 1V. We recommend that sloping/benching be performed using a flat-plated excavator bucket.
6. Where needed, select backfill or structural backfill should be granular material only, free of cinder, brick, asphalt, ash, silt/clay, and other unsuitable materials, compacted to minimum 95% of maximum dry density, and not exceeding 8 inches in loose thickness. All crushed stone should be placed in lifts not exceeding 12 inches in loose thickness. All fill placement shall be subject to special inspection by a special inspector.
7. Final cut for the subgrade for new foundation elements must either be performed by hand, i.e. shovels, or using the flat-plated bucket attached to an excavator. Any over-excavated areas or footing subgrade disturbed by construction or excavation activities must be completely removed and replaced with select backfill or crushed stone and compacted.
8. A pre-construction survey should be performed for any structure or utility within 25 feet of the construction site. A monitoring plan be assembled by an experienced Professional Engineer. We recommend that vibrations be monitored within the existing school building and not exceed 1 ips, and movement of the building be limited to a maximum of ½”, as monitored by optical prism points. Limits subject to modification by the Engineer assembling the monitoring plan.
9. Our recommendations are contingent upon GES being retained for controlled inspections as stated above.

Professional judgments were necessary in relation to determining stratigraphy and soil properties from the subsurface investigations. Such judgments were based partly on the evaluation of the technical information gathered, and partly on our experience with similar projects. If further investigation reveals differences in the subsurface conditions and/or groundwater level, or if the proposed building design is different from indicated herein, or is changed, it is recommended that we be given the opportunity to review the new information and modify our recommendations, if deemed appropriate.

The results presented in this report are applicable only to the present study, and should not be used for any other purpose without our review and consent. This study has been conducted in accordance with the standard of care commonly used as state-of-the-practice in the profession. No other warranties are either expressed or implied.

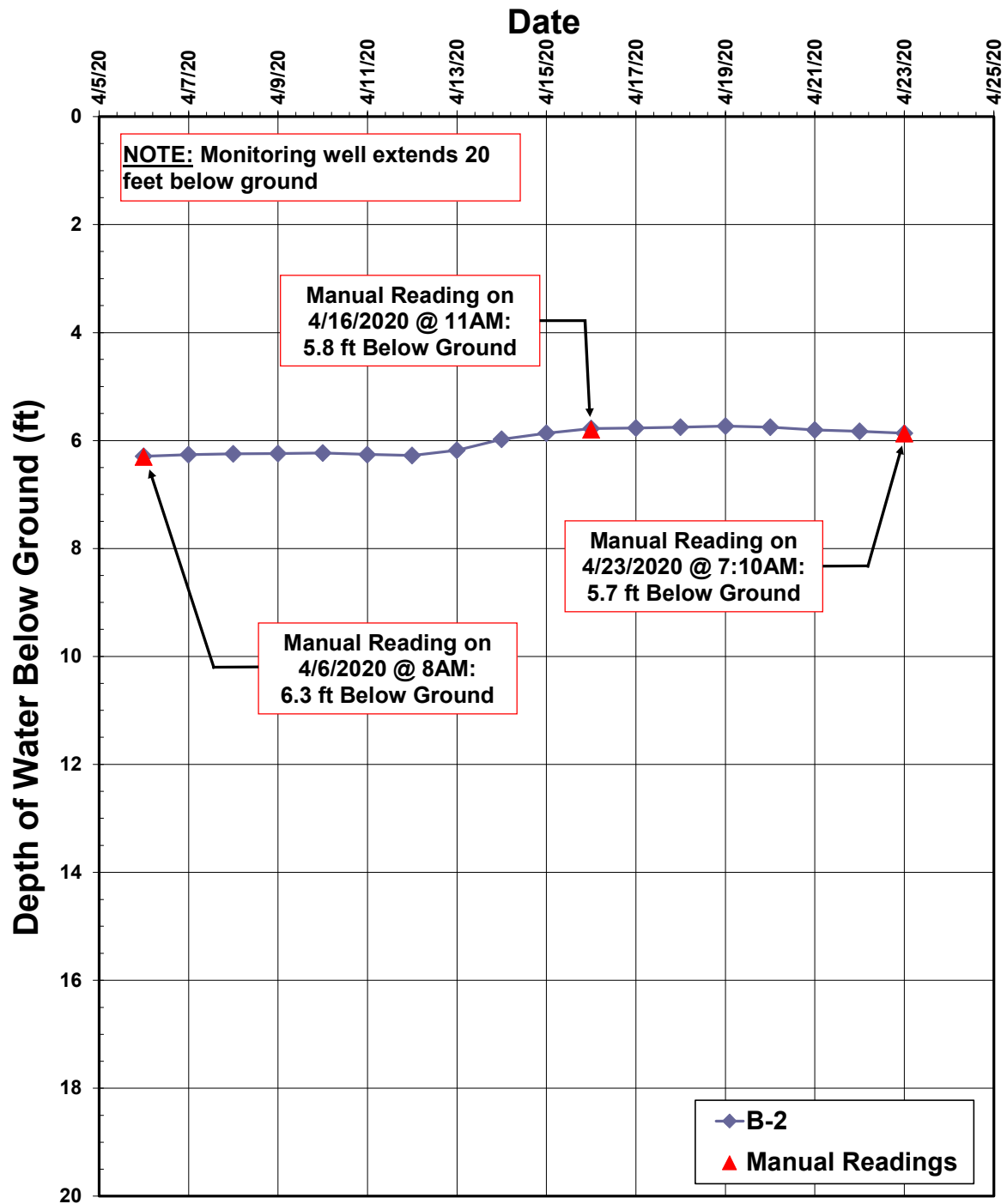
FIGURES



No.	DESCRIPTION	DATE	BY
GES GEOTECHNICAL ENGINEERING SERVICES, P.C. 6 BAYBERRY ROAD ELMSFORD, NEW YORK 10523 PHONE: 914-592-4616 FAX: 914-592-0416			
RYE CITY SCHOOLS MIDLAND ELEMENTARY SCHOOL 312 MIDLAND AVENUE, RYE, NY BLOCK: LOT: ZONE: MAP:			
BORING AND TEST PIT LOCATION PLAN			
<small>UNAUTHORIZED ALTERATION OR ADDITION TO THIS PLAN IS A VIOLATION OF SECTION 7209 OF THE NYS EDUCATION LAW. COPIES OF THIS PLAN NOT BEARING THE PROFESSIONAL ENGINEER'S INKED SEAL OR EMBOSSED SEAL SHALL NOT BE CONSIDERED TO BE A VALID TRUE COPY.</small>			
	PROJECT #:	2020024	
	SCALE:	NTS	
	DATE:	04/21/2020	
	DRAWING NO:	B-100.00	
	SHEET NO:	1 OF 1	

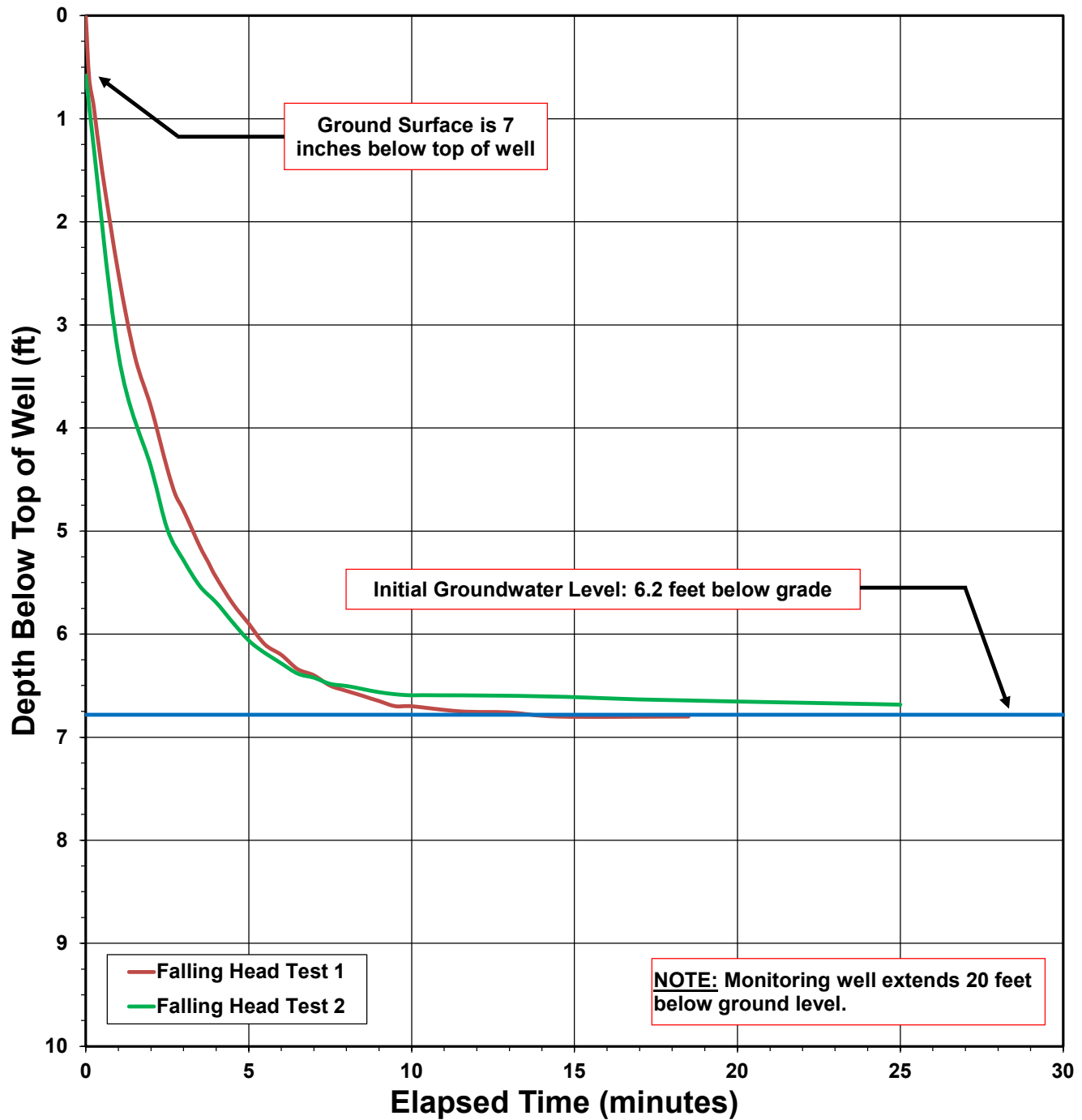
MIDLAND AVENUE (BEYOND)

Midland Elementary School Groundwater Levels



Water Level Readings Boring B-2 Midland Elementary School Rye, NY 10580		
GES, P.C. Elmsford, New York		
DRAWN BY: MT	SCALE: AS SHOWN	PROJ NO: 2020024
CHECKED BY: ZHM	DATE: 4/23/2020	FIGURE NO: 2

Midland Elementary School Falling Head Infiltration Plots



Falling Head Infiltration Plots

Boring B-3

Midland Elementary School

Rye, NY 10580

GES, P.C.

Elmsford, New York

DRAWN BY: MT

SCALE: AS SHOWN

PROJ NO: 2020024

CHECKED BY: ZHM

DATE: 4/10/2020

FIGURE NO: 3

APPENDIX A

Log of Boring B-1

Sheet 1 of 2

Project: Midland Elementary School					Project Number: 2020024					
Location: 312 Midland Avenue, Rye, NY										
Date(s) Drilled	4/6/20 - 4/6/20		Inspector	Aflaaz Saleem		Coordinates		North: East:		
Drilling Agency	MTL		Foreman	Dave Johnson		Approximate Surface Elevation (feet)		NA		
Drilling Equipment	Fordia EMCI 300		Drilling Method	Mud Rotary		Completion Depth (feet)	22.0	Rock Depth (feet)	NA	
Casing Size/Type	4" Steel		Size/Type of Bit	3-7/8" Roller Bit		Sampler Type(s)		2" Split Spoon		
Groundwater Level and Date Measured	NA NA		Hammer Wt/Drop	140/30" (Auto)	Casing Hammer Wt/Drop	140/30" (Auto)			Size/Type of Core Barrel	NA
Boring Location See Boring Location Plan (Figure 1)						No. of Samples			Dist.: 6 Undist.: 0 Core (ft): 0	

Depth, feet	Soil Samples			Rock Coring			Graphic Log	DESCRIPTION	Liquid Limit	Plastic Limit	Water Cont. (%)	% Fines	REMARKS
	Type, Number	Recov. (ft)	Pen. Resist. (blows/6 in)	Run Number	Recov. (%)	RQD (%)							
0								3" Asphalt Slab.					Hand auger to 4 ft.
	HA-1							FILL: Brown Silty medium to fine Sand, some Gravel, Asphalt fragments.					Sample HA-1: Moist
5	S-1A	1.5	7 6 11					Brown and black medium to fine Sand, some Silt, some Gravel.					Cased to 5 ft.
	S-1B	0.3	12					NATURAL: Gray Silty medium to fine Sand, some Clay.					Sample S-1: Dry
	S-2A	0.5	9 8					(SM-SC) Gray Clayey fine to coarse Sand, some Silt.					
	S-2B	0.5	19 25					(SC-SM) Gray Silty medium to fine Sand.					Sample S-2: Dry
	S-3	0.0	6 8 8 8					No Recovery Presumed Same As Above. (SM)					
10	S-4	0.9	7 9 18 18					Brown and gray coarse to fine Sand, some Gravel, trace Silt. (SP)					Sample S-4: Wet
15	S-5	0.7	6 3 4 9					Brown medium to fine Sand, some Gravel, trace Silt. (SP)					Sample S-5: Wet
20													

Template: GENERAL GES LOGO Proj ID: RYE MIDLAND SCHOOL.GPJ

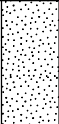
GES P.C.

Printed: 4/23/20

Log of Boring B-1

Sheet 2 of 2

Project: Midland Elementary School	Project Number: 2020024
Location: 312 Midland Avenue, Rye, NY	

Depth, feet	Soil Samples			Rock Coring			Graphic Log	DESCRIPTION	Liquid Limit	Plastic Limit	Water Cont. (%)	% Fines	REMARKS
	Type, Number	Recov. (ft)	Pen. Resist. (blows/6 in)	Run Number	Recov. (%)	RQD (%)							
20	S-6	1.0	11 12 12 16					Red brown coarse to fine Sand, some coarse Gravel, trace Silt (SP)					Sample S-6: Wet
25								Boring completed at 22 ft. Backfilled with soil cuttings mixed with grout upon completion.					
30													
35													
40													

Template: GENERAL GES LOGO Proj ID: RYE MIDLAND SCHOOL.GPJ

Log of Boring B-2

Sheet 1 of 2

Project: Midland Elementary School						Project Number: 2020024						
Location: 312 Midland Avenue, Rye, NY												
Date(s) Drilled	4/2/20 - 4/3/20		Inspector	Ahmed Obidat			Coordinates		North: East:			
Drilling Agency	MTL		Foreman	Dave Johnson			Approximate Surface Elevation (feet)		NA			
Drilling Equipment	Fordia EMCI 300		Drilling Method	Mud Rotary			Completion Depth (feet)	20.0	Rock Depth (feet)	NA		
Casing Size/Type	4" Steel		Size/Type of Bit	3-7/8" Roller Bit			Sampler Type(s)		2" Split Spoon			
Groundwater Level and Date Measured	NA NA		Hammer Wt/Drop	140/30" (Auto)		Casing Hammer Wt/Drop	140/30" (Auto)		Size/Type of Core Barrel	NA		
Boring Location See Boring Location Plan (Figure 1)							No. of Samples			Dist.: 10	Undist.: 0	Core (ft): 0

Depth, feet	Soil Samples			Rock Coring			Graphic Log	DESCRIPTION	Liquid Limit	Plastic Limit	Water Cont. (%)	% Fines	REMARKS
	Type, Number	Recov. (ft)	Pen. Resist. (blows/6 in)	Run Number	Recov. (%)	RQD (%)							
0													
	HA-1							FILL: Dark brown medium to fine Sand, trace Silt, Roots.					Hand auger to 4 ft.
	HA-2							NATURAL: Brown coarse to fine Sand, some coarse to fine Gravel, trace Silt. (SP)					Sample HA-1: Moist
													Sample HA-2: Moist
5	S-1	1.7	5 4 3 4					Brown coarse to fine Sand, some coarse to fine Gravel, trace Silt, Clay. (SP)					Sample S-1: Moist
	S-2	2.0	3 4 5 7					Brown Sandy Silt (ML)	29	24	39	63	Rig chatter at 6 ft.
	S-3A	0.5	2 1					Same as above. (ML)					Sample S-2: Wet Cased to 5 ft.
	S-3B	0.8	3 4					Red brown coarse to fine Sand, trace coarse to fine Gravel, Silt. (SP)					Sample S-3: Wet
10	S-4	0.9	3 4 3 6					Red brown coarse to fine Sand, some coarse to fine Gravel, trace Silt. (SP)					Sample S-4: Wet
													Rig chatter at 11 ft.
	S-5A	0.8	2 2					Brown medium to fine Sand, some Clay, trace Silt. (SC)					Sample S-5: Wet
	S-5B	1.0	5 7					Red brown coarse to fine Sand, some coarse to fine Gravel, trace Silt (SP)					
15	S-6	0.8	5 5 6 9					Red brown coarse to fine Sand, some medium to fine Gravel, trace Silt. (SP)					Sample S-6: Wet
	S-7	0.9	9 8 6 11					Red brown coarse to fine Sand, some coarse to fine Gravel, trace Silt (SP)					Sample S-7: Wet
													Rig chatter at 17 ft.
	S-8	1.1	4 7 8 13					Same as above. (SP)					Sample S-8: Wet
20													

GES P.C.

Printed: 4/23/20

Log of Boring B-2

Sheet 2 of 2

Project: Midland Elementary School	Project Number: 2020024
Location: 312 Midland Avenue, Rye, NY	

[illegible]

Template: GENERAL GES LOGO Proj ID: RYE MIDLAND SCHOOL.GPJ

GES P.C.

Printed: 4/23/20

Log of Boring B-3

Sheet 1 of 2

Project: Midland Elementary School					Project Number: 2020024				
Location: 312 Midland Avenue, Rye, NY									
Date(s) Drilled	4/3/20 - 4/6/20	Inspector	Ahmed Obidat/Mike Torino, P.E.			Coordinates	North: East:		
Drilling Agency	MTL	Foreman	Dave Johnson			Approximate Surface Elevation (feet)	NA		
Drilling Equipment	Fordia EMCI 300	Drilling Method	Mud Rotary			Completion Depth (feet)	26.0	Rock Depth (feet)	NA
Casing Size/Type	4" Steel	Size/Type of Bit	3-7/8" Roller Bit			Sampler Type(s)	2" Split Spoon		
Groundwater Level and Date Measured	NA NA	Hammer Wt/Drop	140/30" (Auto)	Casing Hammer Wt/Drop	140/30" (Auto)	Size/Type of Core Barrel	NA		
Boring Location See Boring Location Plan (Figure 1)						No. of Samples	Dist.: 12 Undist.: 0 Core (ft): 0		

Depth, feet	Soil Samples			Rock Coring			Graphic Log	DESCRIPTION	Liquid Limit	Plastic Limit	Water Cont. (%)	% Fines	REMARKS
	Type, Number	Recov. (ft)	Pen. Resist. (blows/6 in)	Run Number	Recov. (%)	RQD (%)							
0													
	HA-1							FILL: Dark brown medium to fine Sand, trace Silt and roots.					Hand auger to 4 ft.
	HA-2							NATURAL: Tan coarse to fine Sand, trace fine Gravel, Silt, Clay. (SM-SC)					Sample HA-1: Moist
													Sample HA-2: Moist
													Cased to 4 ft.
5	S-1	1.5	5 5 5 6					Brown coarse to fine Sand, trace medium to fine Gravel. (SP)					Sample S-1: Moist
	S-2A	0.3	4					Same as above. (SP)					Possible contamination.
	S-2B	0.4	6					Brown and gray medium to fine Sand, some Clay. (SC)					Sample S-2: Moist
	S-2C	1.0	12 15					Brown coarse to fine Sand, some coarse to fine Gravel, trace Silt. (SP)					Sample S-2: Moist
	S-3A	0.5	4 7					Brown Sandy Silt, trace root fragments (ML)					Cased to 8 ft.
	S-3B	0.6	11 9					Dark brown coarse to fine Sand, some coarse to fine Gravel, trace Silt. (SP)					Sample S-3B: Wet
10	S-4	1.2	12 20 35 29					Brown coarse to fine Sand, some coarse to fine Gravel. (SP)					Sample S-4: Wet
													Rig chatter from 11 to 12 ft.
	S-5	1.3	23 20 23 13					Brown Well-graded Gravel, some coarse to fine Sand, Silt (GW-GM)			11	6	Sample S-5: Wet
	S-6	0.9	5 11 9 8					Brown Well-graded Gravel, some coarse to fine Sand, Silt, trace Clay (GW-GM)					Rig chatter from 13 to 14 ft.
15	S-7A	0.8	21 25 42					Same as above. (GW-GM)					Sample S-6: Wet
	S-7B	0.2	27					Gray decomposed Rock fragments, some coarse to fine Sand. (SP)					Rig chatter at 18 ft.
	S-8	1.0	21 82 50/2"					Gray decomposed rock fragments, some coarse to fine Sand, some coarse to fine Gravel. (SP)					Spoon refusal at 19.2 ft.
20													

GES P.C.

Printed: 4/23/20

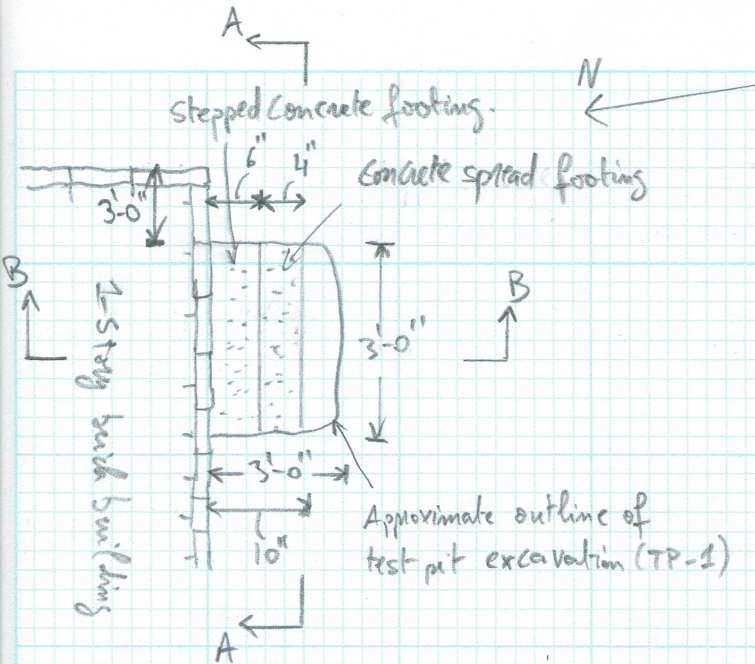
Log of Boring B-3

Sheet 2 of 2

Project: Midland Elementary School	Project Number: 2020024
Location: 312 Midland Avenue, Rye, NY	

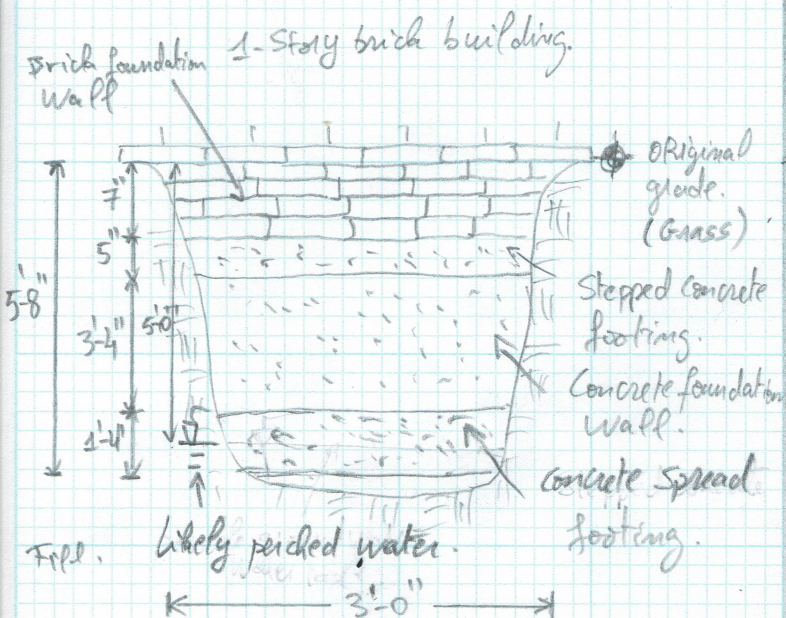
Depth, feet	Soil Samples			Rock Coring			Graphic Log	DESCRIPTION	Liquid Limit	Plastic Limit	Water Cont. (%)	% Fines	REMARKS
	Type, Number	Recov. (ft)	Pen. Resist. (blows/6 in)	Run Number	Recov. (%)	RQD (%)							
20													
	S-9	0.8	47 86 40/2"					Same as above. (SP)					Sample S-9: Wet Rig chatter from 21 to 26 ft. Spoon refusal at 22.2 ft.
25													Sample S-10: Spoon attempted at 26 ft. no penetration, bouncing.
30								Boring completed at 26 ft. Backfilled with soil cuttings mixed with grout upon completion.					
35													
40													

APPENDIX B

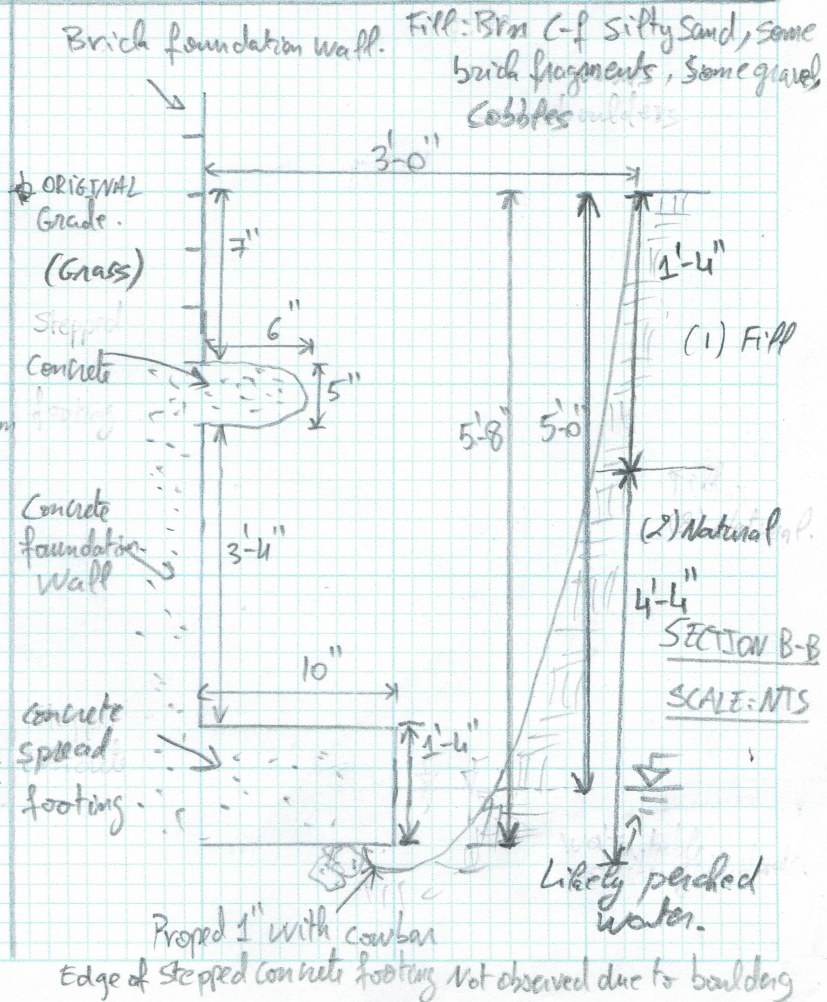


Notes:

1. GES on site to witness test pit excavation on 4/12/20
2. Test pit excavated and backfilled by hand tools by Municipal Testing Laboratory (MTL) from Hauppauge, NY.
3. Test pit location not selected by GES.
4. Test pit performed from existing grade
5. No bedrock encountered during excavation
6. Likely perched water encountered at 5 feet depth below existing grade.
7. GES on site for backfilling and compaction in one foot maximum in lifts with hand tools on 4/13/20
8. Grass replaced back at the top of the test pit hole with grass seeds.
9. All excavated material removed from site.



- (1) Fill: Brown c-f Silty Sand, some brick fragments, some gravel, cobbles.
- (2) Natural: Tan and brown c-f Silty Sand, some gravel, cobbles.



APPENDIX C



Client Name:

Ms. Gabrielle O'Connor, Asst. Superintendent for Business
Rye City School District
555 Theodore Fremd Ave, Suite B 101
Rye, NY 10580

Site Location:

Midland Elementary School
312 Midland Avenue
Rye, New York

Project No.

2020024

Photo No.

1

Date:

04-02-20

Direction:

Plan View
Facing East

Description:

TP-1

Top of Concrete
Footings



Photo No.

2

Date:

04-02-20

Direction:

Plan View
Facing North

Description:

TP-1

Possible groundwater
encountered at 5.0 feet
below grade

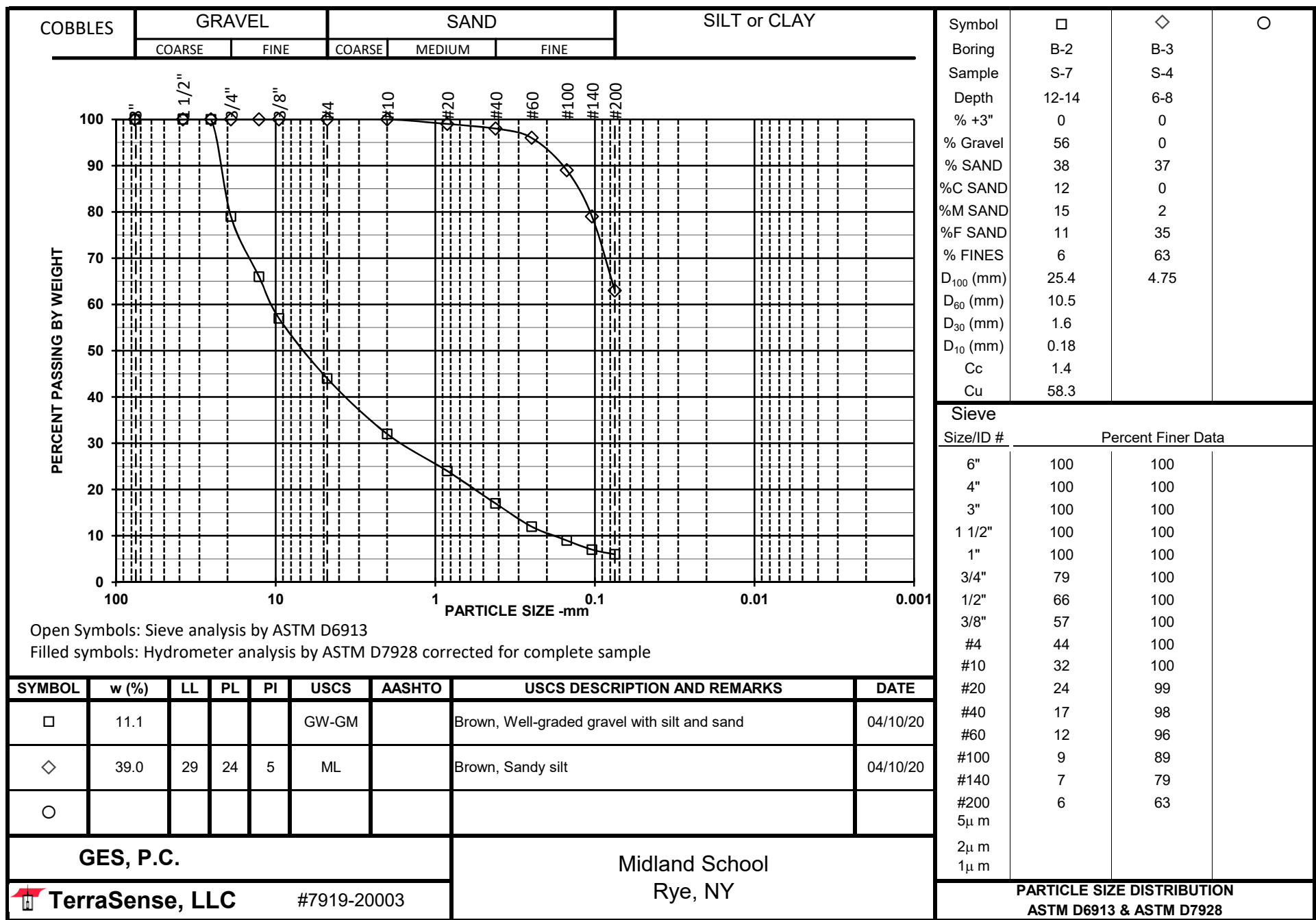


APPENDIX D

GES, P.C.
Midland School - Rye, NY
LABORATORY TESTING DATA SUMMARY

BORING NO.	SAMPLE NO.	DEPTH (ft)	IDENTIFICATION TESTS						REMARKS
			WATER CONTENT (%)	LIQUID LIMIT (-)	PLASTIC LIMIT (-)	PLAS. INDEX (-)	USCS SYMB. (1)	SIEVE MINUS NO. 200 (%)	
B-2	S-7	12-14	11.1				GW-GM	6	
B-3	S-4	6-8	39.0	29	24	5	ML	63	

Note: (1) USCS symbol based on visual observation and Sieve and Atterberg limits reported.



SECTION 023000
SOIL TESTING SERVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. Related Work Specified Elsewhere:

Section 31 23 00: Earthwork.

Section 31 22 13: Rough Grading.

Section 31 23 16: Trenching, Backfilling and Compaction.

Section 32 10 00: Roadway and Miscellaneous Subbase.

Section 32 91 13: Soil Preparation and Soil Mixes.

1.2 QUALITY ASSURANCE

A. Laboratory services are solely an assurance that contract provisions are met.

B. Forward copies of test results to Architect, Owner, Construction Manager, and Owner's Representatives within ten (10) days.

C. Testing Agency/Testing Laboratory Qualifications:

1. Agencies shall have not less than five (5) years experience in testing services required on comparable construction projects.
2. Soil testing agency shall be an established geotechnical firm with a Geotechnical Engineer on staff that is licensed in the State of New York. The Contractor shall provide the firm with a copy of the contract drawings and specifications in order that the firm may be able to become thoroughly familiar with the project requirements prior to commencing site inspection and testing services.

PART 2 - PRODUCTS (Not used)

PART 3 - EXECUTION

3.1 TESTING LABORATORY SERVICES

- A. The Owner, at his own expense, shall obtain the testing services of a geotechnical engineering and testing firm that is regularly engaged in the testing of construction materials.**

3.2 RESPONSIBILITIES AND DUTIES OF CONTRACTOR

- A. To facilitate testing services, the Contractor shall:**

1. Furnish to the Testing Agency laboratory such samples of materials as may be necessary for testing purposes.
 2. Furnish such casual labor, equipment, and facilities as is necessary to obtain and handle samples at the project.
 3. Advise the Testing Agency sufficiently in advance of operations to allow for completion of tests and for the assignment of personnel.
 4. Provide safe access to items to be tested. This includes sheeting and ladders for deep excavations.
- B. If any portion of the work shows low test results or evidence of detrimental placing, the Construction Manager may require additional testing, compaction, or removal and replacement of soil materials at the Contractor's expense. In no case shall the inspector prescribe the method of repair of the defect.

3.3 QUALITY CONTROL

- A. Testing Agency shall perform the following tests and inspections:
1. Subgrades, Fill and Compaction:
 - a. Inspection of proofrolling operations including specifying undercuts as necessary. Undercuts shall be at Contractor's expense.
 - b. Inspection of subgrades upon which select fill, porous fill, subbases at concrete and asphaltic pavements or foundations are to be placed.
Verification shall be made by the Testing Agency that all deleterious fill materials have been removed in accordance with the specifications.
 - c. Sieve analysis of proposed fill materials. Minimum one test for each 1,000 cubic yards of imported materials delivered to site.
 - d. Optimum moisture - maximum density curve for each soil used for backfill in accordance with ASTM D1557, Method A.
 - e. Tests in accordance with ASTM D-1577 of actual in-place density for each strata placed.

3.4 FREQUENCY OF TESTING

- A. The frequency of in-place density testing per lift of compacted material shall be in accordance with the following table. Minimums apply when areas to be tested are less than the designated unit.

	NO. OF TESTS	PER UNIT	MINIMUM NO. OF TESTS PER LIFT
Trenches (includes per LF of large diameter underground storage pipe)	1	200 L.F.	2 For Each Type, Run or Size
Sidewalks	1	1,000 S.F.	5

Parking Areas	1	5,000 S.F.	8 For Each Separate Area
Roadways (Up to 30' Nominal Width)	1	200 L.F.	5
Building Slabs	1	1,000 S.F.	5
Footings and Piers	1	100 L.F. or Pier	2 for Footings, 1 Per Pier
Detention Basin	1	200 C.Y.	2
Embankment or Subgrade	1	2,000 L.F.	5

- B. Frequency of testing may be increased at the discretion of the Owner, Engineer, Architect, or Construction Manager. Additional testing of re-compacted soils shall be at the expense of the Contractor.

END OF SECTION 023000

SECTION 02 41 19

SELECTIVE DEMOLITION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, including General Conditions, Modifications, and Division 1 General Requirements, apply to the work of this section.

1.2 WORK INCLUDED

- A. Selectively cut out and remove materials, systems, equipment, and structures indicated on the Drawings, including, but not limited to:
 - 1. Removal of existing walls, fenestration and finishes.
 - 2. Salvage existing masonry for use in patching and repair of walls.
 - 3. Cutting and patching at connections to existing buildings.
 - 4. Structural items where indicated.
 - 5. Mechanical, plumbing, and electrical items as indicated.
 - 6. All other demolition work indicated on the Drawings.
- B. Refer to Section 02 41 13 Selective Site Demolition as well as Structural Drawings, Mechanical Drawings, and Electrical Drawings for additional demolition work.

1.3 SUBMITTALS

- A. The following shall be submitted:
 - 1. Permit for transport and legal disposal off-site of demolition material and debris.
 - 2. Selective demolition procedures and operational sequence for review and acceptance by Architect.

1.4 JOB CONDITIONS

- A. Occupancy: Adjacent buildings will be occupied throughout the construction.
- B. Condition of Items and Structures: The Owner assumes no responsibility for the actual condition of items and structures to be demolished.
- C. Partial Demolition and Removal: Items indicated to be removed but of salvageable value to the Contractor may be removed from the building as work progresses. Transport items from site as they are removed. Sale or storage of items at the site will not be permitted.

1.5 PROTECTION

- A. Maintain access to and egress from the building.
- B. Prevent movement or settlement of adjacent structures. Provide and place bracing or shoring and be responsible for safety and support of structures. Assume liability for such movement, settlement, damage, or injury.
- C. Cease operations and notify Architect immediately if safety of adjacent facilities or structures appears to be endangered. Take precautions to properly support structures. Do not resume operations until safety is restored.
- D. Temporary Protections: Provide temporary enclosures, barricades and other forms of protection as required to for protection of personnel from injury due to selective demolition operations.
 - 1. Provide shoring and bracing as required to prevent collapse of existing systems and adjacent facilities or work to remain.
 - 2. Provide secure temporary enclosure and weather barrier where sections of existing exterior walls are penetrated or removed. Prevent moisture penetration and protect existing construction to remain.
 - 3. Protect existing finish work that is to remain from damage from demolition operations.
 - 4. Construct temporary dustproof and insulated partitions where required to separate areas where noisy and dusty operations are performed.
 - 5. Remove temporary protections at completion of the work.
- E. Utility Services: Maintain existing utilities serving adjacent occupied or used facilities. Coordinate with Owner. NO INTERRUPTION of building services to adjacent occupied areas of the buildings will be permitted.

PART 2 PRODUCTS

2.1 SALVAGING

- A. Schedule at end of this Section indicates materials to be salvaged and responsibility for removal and handling.
 - 1. Items indicated to be removed by Contractor (or any items not indicated as removed by Owner) shall be carefully removed and delivered to the Owner at locations determined by Owner.
 - 2. Where items are indicated to be removed by Owner's personnel, Contractor shall coordinate with Owner and provide access to required areas of site to permit removals.
 - 3. Items indicated or required for use in the Work are required to be carefully removed by the Contractor and stored on site to allow for undamaged material to be reused.

- B. Salvaged materials required to be delivered to the Owner or removed by the Owner shall be as indicated on the attached schedule at the end of this Section.
- C. Mechanical and electrical items to be salvaged shall be protected from the weather.

PART 3 EXECUTION

3.1 INSPECTION

- A. Prior to commencement of selective demolition work, inspect areas in which work will be performed. Note and photograph existing conditions which could be misconstrued as damaged resulting from selective demolition work.

3.2 PREPARATION

- A. Cover and protect existing finishes, fixtures and equipment to remain. Protect from soiling, dust, or damage during demolition work.
- B. Erect and maintain dust and noise proof partitions.
- C. Locate, identify, stub-off, and disconnect utility services that are indicated not to remain. Provide by-pass services as necessary to maintain continuity of service to occupied areas. Make safe all utility services to remain and/or to later be connected to new work.

3.3 SELECTIVE DEMOLITION

- A. Perform selective demolition work in a systematic manner. Items indicated to be removed shall be completely removed.
- B. Remove debris from site and dispose of legally.

3.4 SALVAGE MATERIALS

- A. Where items are indicated to be removed and salvaged by Owner, coordinate demolition schedule to allow access and permit materials to be removed prior to performing other operations which might damage salvage materials.
- B. Where items are indicated to be removed by Contractor and salvaged for delivery to Owner, carefully remove indicated items, clean items, and deliver to storage area designated by Owner.
- C. Where items are indicated to be removed and salvaged for reuse in the Work, carefully remove indicated items, clean items, and store in a protected area on the project site.
 - 1. Brick
 - 2. 2 x 2 ceiling tile and grid

3. Stone cladding and paver materials

3.5 DISPOSAL OF MATERIALS

- A. Material resulting from selective demolition and not identified for salvaging shall become the property of the Contractor and shall be legally transported and disposed of off-site. Disposal shall be performed as promptly as possible and not left until the final clean up.

END OF SECTION

SECTION 032100

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.1 WORK INCLUDED:

This section of the specification covers the furnishing and installation of reinforcement for cast-in-place concrete.

1.2 RELATED WORK:

- A. Section 32 13 13, PORTLAND CEMENT CONCRETE PAVEMENT

1.3 SYSTEM DESCRIPTION:

Materials and construction shall conform to ACI 318 and ACI 350 unless otherwise noted on the design drawings or modified herein.

1.4 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF GENERAL SPECIFICATIONS, SUBMIT THE FOLLOWING:

- A. The Contractor shall furnish the Engineer with complete checked, reinforcing steel shop drawings and bar lists. Shop drawing shall include grade of steel used as well as splice lengths.
- B. Mill test reports shall accompany drawings. Fabrication shall not commence until the drawings and mill test reports have been released by the Engineer.
- C. When fiber reinforcement is used, contractor shall submit manufacturer's data confirming that material meets the specification.

1.5 REFERENCES:

- A. The following standards form a part of these specifications:

American Concrete Institute (ACI)	
ACI 318	Building Code Requirements for Concrete
ACI 347	Recommended Practice for Concrete Formwork
ACI 350	Environmental Engineering Concrete Structures
ACI SP-66	ACI Detailing Manual American Society for Testing and Materials (ASTM)
ASTM A185	Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement

ASTM	A497	Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement
ASTM	A615	Deformed Billet-Steel Bars for Concrete Reinforcement
ASTM	A775	Epoxy-coated Reinforcing Steel Bars
ASTM	A884	Epoxy-coated Welded Wire Fabric
		American Welding Society (AWS)
AWS	12.1	Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction

PART 2 - PRODUCTS

2.1 MATERIALS:

- A. Steel reinforcing bars shall conform to ASTM A615, Grade 60, and A775 if epoxy-coated bars are specified.
- B. Welded steel wire fabric shall conform to ASTM A185 or ASTM A497 and ASTM A884 if epoxy-coated fabric is specified. Gauge and spacing of wires shall be as indicated on the drawings.
- C. Reinforcing steel shall be detailed in accordance with ACI SP-66 modified as applicable to conform to ACI 350.
- D. Reinforcement shall be accurately formed to the dimensions indicated on the drawings. Bars shall be shipped to the site with bars of the same size and shape, fastened in bundles with securely wired-on metal identification tags listing both size and mark.
- E. Any bar showing cracks after bending shall be discarded.
- F. Steel failing to meet the requirements of this specification or the drawings will be rejected and shall be removed from the site immediately.

2.2 FIBER REINFORCEMENT

When called for on the drawings, concrete engineered reinforcing fibers shall be polypropylene, collated, fibrillated fibers from Fibermesh Co., 4019 Industry Drive, Chattanooga, TN; Forta Corporation, One Hundred Forta Drive, Grove City, PA; or approved equal. Only fibers designed and manufactured specifically for use in concrete from virgin polypropylene and so certified by the manufacturer shall be acceptable.

PART 3 - EXECUTION

3.1 STEEL INSTALLATION:

- A. Before being placed in position, reinforcement shall be thoroughly cleaned of loose mill and rust scale, dirt, and other coatings (including ice), that reduce or destroy bond. When there is a delay in depositing concrete after reinforcement is in place, bars shall be reinspected and cleaned as necessary.
- B. After forms have been oiled, but before concrete is placed, all steel shall be securely wired in the exact position called for, and shall be maintained in that position until all concrete is placed and compacted. Chair bars and supports shall be provided in a number and arrangement satisfactory to the Engineer.
- C. Concrete blocks having a minimum bearing area of 2-inches by 2-inches and equal in quality to that specified for the slab, shall be used for supporting reinforcing bars for slabs on grade. Wood blocks, stones, brick chips, etc., shall not be used to support reinforcement.
- D. Metal supports shall be of types that will not penetrate the surface of formwork or slab and which will not show through or stain surfaces that are to be exposed to view, painted or unpainted.
- E. Welding of reinforcing bars will be permitted only where permission of the Engineer has been obtained in advance. Such welding shall be performed only under conditions established by the Engineer, and in accordance with AWS 12.1.
- F. Reinforcement, which is to be exposed for a considerable length of time after having been placed, shall be painted with a heavy coat of cement grout, if required by the Engineer.

3.2 FIBER INSTALLATION:

- A. Fibermesh fibers shall be used in concrete as indicated on the drawings or as specified and in strict accordance with the manufacturer's recommendations as to type and amount. The fiber manufacturer or approved distributor shall provide the services of a qualified employee for pre-job meeting and initial job start up.

END OF SECTION 032100

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. General Notes, Sections, Plans, Typical Details, and other notes indicated on the structural drawings. In cases of conflict, information indicated on the structural drawings shall govern.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Qualification Data: For Installer, manufacturer, and testing agency.
- E. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
 - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- F. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.

2. Admixtures.
 3. Form materials and form-release agents.
 4. Steel reinforcement and accessories.
 5. Fiber reinforcement.
 6. Waterstops.
 7. Curing compounds.
 8. Floor and slab treatments.
 9. Bonding agents.
 10. Adhesives.
 11. Vapor retarders.
 12. Semirigid joint filler.
 13. Joint-filler strips.
- G. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.
- H. Field quality-control test and inspection reports.
- I. Minutes of preinstallation conference.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated, as documented according to ASTM E 548.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-01 or an equivalent certification program.
 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.

- E. ACI Publications: Comply with the following (latest editions) unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specification for Structural Concrete," Sections 1 through 5 and Section 7, "Lightweight Concrete.", and Section 8, "Mass Concrete".
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 - 3. ACI 302.1R "Guide for Concrete Floor and Slab Construction"
- F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, concrete repair procedures, and concrete protection.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements and the approval of the architect and engineer, products that may be incorporated into the Work include, but are not limited to, products specified.

2.2 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 1. Plywood, metal, or other approved panel materials.
 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- E. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- F. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- G. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, deformed, grade as indicated on the contract drawings.
- B. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, grade as indicated on the contract drawings, deformed bars, ASTM A 775/A 775M or ASTM A 934/A 934M, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.
- C. Plain-Steel Wire: ASTM A 82, as drawn.
- D. Deformed-Steel Wire: ASTM A 496.
- E. Epoxy-Coated Wire: ASTM A 884/A 884M, Class A, Type 1 coated, as-drawn, plain-steel wire, with less than 2 percent damaged coating in each 12-inch wire length.
- F. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets.
- G. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A coated, Type 1, plain steel.

2.4 REINFORCEMENT ACCESSORIES

- A. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 - 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

2.5 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150 or ASTM C-1157, Type I/II, gray. Supplement with the following where indicated on the drawings:
 - a. Slag Cement used as a separate component in a concrete mixture: ASTM C-989 Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortar.

- b. Slag cement replacement levels shall not exceed 25% as a pound-for-pound replacement for portland cement in the concrete mixture.
 - c. Slag Cement when used as part of a blended cement: ASTM C-595 Specification for Blended Hydraulic Cements. Slag cement replacement levels shall not exceed 25% as a pound-for-pound replacement for portland cement in the concrete mixture.
 - d. Pozzolans (including fly ash): ASTM C-618, Class C. Pozzolan replacement levels shall not exceed 25% as a pound-for-pound replacement for portland cement in the concrete mixture.
 - e. Silica Fume: ASTM C-1240
- B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Lightweight Aggregate: ASTM C 330, 1/2-inch nominal maximum aggregate size.
- D. Water: ASTM C 94/C 94M and potable.

2.6 MASS CONCRETE

- A. Materials in foundations with least dimension of 5 feet or more shall be considered mass concrete and placement shall conform to ACI 301 Section 8 "Mass Concrete".

2.7 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 - 2. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
- C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.

1. Available Products:

- a. Grace Construction Products, W. R. Grace & Co.; DCI.
- b. Master Builders, Inc.; Rheocrete CNI.
- c. Sika Corporation; Sika CNI.

2.8 FIBER REINFORCEMENT

- A. Carbon-Steel Fiber: ASTM A 820, deformed (minimum 25 lb/cu yd), "Novomesh 850" by SI Concrete Systems or approved equal. (to be used only where specifically indicated or approved by the architect and structural engineer).

2.9 WATERSTOPS

- A. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch, or equal product approved by the architect and engineer.
 - 1. Available Products
 - a. Colloid Environmental Technologies Company (CETCO). WATERSTOP-RX

2.10 VAPOR RETARDERS

- A. Plastic Vapor Retarder: ASTM E 1745, Class A, minimum 20 mils thickness. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.11 CURING MATERIALS

- A. Clear, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A or ASTM C 309, Class A.
- B. All curing and sealing compounds at areas to receive flooring must be approved by the flooring installer for compatibility.

2.12 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.
- B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 per ASTM D 2240.
- C. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

- D. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- E. Reglets: Fabricate reglets of not less than 0.0217-inch- thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- F. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.13 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301. Proportioning of concrete mix shall performed according to ACI 211.1
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 25 percent. (where indicated on structural drawings)
 - 2. Slag Cement: 25 percent. (where indicated on structural drawings)
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing or high-range water-reducing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - 3. Use corrosion-inhibiting admixture in concrete mixtures where indicated on structural drawings.

2.14 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Proportion normal-weight concrete mixture as follows (or as indicated on the structural drawings):
 - 1. Minimum Compressive Strength: as indicated on the contract drawings.

2. Maximum Water-Cementitious Materials Ratio: as indicated on the contract drawings.
 3. Slump Limit: as indicated on the structural drawings.
 4. Air Content: as indicated on the structural drawings for all concrete exposed to freeze/thaw, no air entrainment for other concrete.
 - 5.
- B. Topping Slabs: Proportion structural lightweight concrete mixture as follows (or as indicated on the structural drawings):
1. Minimum Compressive Strength: as indicated on the contract drawings.
 2. Calculated Equilibrium Unit Weight: 115 lb/cu. ft., plus or minus 5 lb/cu. ft. as determined by ASTM C 567.
 3. Slump Limit: as indicated on the structural drawings.
 4. Air Content: Air content of trowel finished floors shall not exceed 3 percent.

2.15 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.16 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

2.17 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
1. Class A, 1/8 inch for smooth-formed finished surfaces.
 2. Class B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete

surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

2.18 EMBEDDED ITEMS

- A. Specify embedded items and anchorage devices for other work attached to or supported by cast-in-place concrete. Add specific requirements for installing embedded items, if any, that are part of the Work.
- B. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 3. Install dovetail anchor slots in concrete structures as indicated.

2.19 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
 - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
 - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect and engineer.

2.20 SHORES AND RESHORES

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

2.21 VAPOR RETARDERS

- A. Plastic Vapor Retarders: Place, protect, and repair vapor retarders according to ASTM E 1643 and manufacturer's written instructions.
 - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.

2.22 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.
- F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

2.23 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect and engineer.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of pile caps and grade beams or floor slabs.
 - 4. Space vertical joints in walls as indicated on structural drawings. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible. Provide approved waterstop in all joints.
 - 5. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 6. Provide joint filler material and waterstop capable of bridging building expansion joints where such joints are indicated on the structural or architectural drawings.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, or as indicated on the structural drawings, as follows:
 - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
 - 2. Sawcut joints within 4 hours of placement using an early entry dry-cut saw.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

2.24 WATERSTOPS

- A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, adhesive bonding, mechanically fastening, and firmly pressing into place. Install in longest lengths practicable.

2.25 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect and engineer.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

- E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- F. Hot-Weather Placement: Comply with ACI 301 and as follows:
 - 1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
- G. Conform to ACI 301 Section 8 – “Mass Concrete” for placement of concrete in excess of 5 feet in total thickness, including all mat slabs and thick pile caps shown on the structural drawings.

2.26 FINISHING FORMED SURFACES

- A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view, and where indicated by the architectural drawings.
- B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

2.27 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. All floor finishes shall be reviewed and approved by the architect prior to placement of concrete.

- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces indicated on the architectural drawings.
- D. Steel trowel interior floor slabs scheduled to be exposed.
- E. Trowel and Fine-Broom Finish: Apply a first trowel finish to all exterior concrete slabs, paving, and steps, and where ceramic or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom. Comply with flatness and levelness tolerances for trowel finished floor surfaces.
- F. Harden and seal floors as scheduled by the architect.

2.28 MISCELLANEOUS CONCRETE ITEMS

- A. Concrete encasement of steel columns: provide concrete encasement of steel columns using details indicated on the structural drawings.
- B. Pile cap anchorage: extend precast pile reinforcement strands into pile cap and provide anchors for strands capable of developing the tensile loads indicated on the structural drawings. Submit test data and product information for anchorage device to architect and engineer for approval.
- C. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- D. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- E. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- F. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

2.29 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- C. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- A. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 - 1. After placing and finishing, use one or more of the following methods to preserve moisture in concrete:
 - a. Ponding, continuous fogging, or continuous sprinkling;
 - b. Application of mats or fabric kept continuously wet;
 - c. Continuous application of steam (under 150 °F);
 - d. Application of sheet materials conforming to ASTM C171
 - 2. Curing and Sealing Compound:
 - a. Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions.
 - b. Curing compound shall be applied immediately after slabs are finished. Recoat areas subjected to heavy rainfall within three hours after initial application.
 - c. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.
 - d. All curing and sealing compounds at areas to receive flooring must be approved by the flooring installer for compatibility.

2.30 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least two month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.
- D. Provide joint filler capable of bridging building expansion joints where required on the structural or architectural drawings.

2.31 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect and engineer. Remove and replace concrete that cannot be repaired and patched to Architect and engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one-part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect and engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 - 5. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact

patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

- E. Unless noted otherwise, provide a minimum floor slab flatness (Ff) of 25, and a minimum floor slab levelness (Fl) of 25 (levelness applies to slabs on grade only). Flatness and levelness (where applicable) shall be verified in the field using a profilograph within 72 hours of placement. Provide corrective action where floor levelness and/or flatness is not within specified tolerances.
- F. Perform structural repairs of concrete, subject to Architect and engineer's approval, using epoxy adhesive and patching mortar.

2.32 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- B. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Headed bolts and studs.
 - 3. Verification of use of required design mixture.
 - 4. Concrete placement, including conveying and depositing.
 - 5. Curing procedures and maintenance of curing temperature.
 - 6. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain at least one composite sample for each 50 cu. yd. or fraction thereof of each concrete mixture placed each half day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.

5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure three sets of two standard 12" cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
 - a. Test one set of two field-cured specimens at 7 days; one set of two specimens at 28 days; and one set of two specimens at 56 days (if required due to low strength at 28 days).
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated. If one specimen in a test shows evidence of improper sampling, molding, or testing, discard the specimen and consider the strength of the remaining cylinder to be the test result. If both specimens in a test show any defects, discard the entire test.
8. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
9. Test results shall be reported in writing to Architect and engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect and engineer but will not be used as sole basis for approval or rejection of concrete.
11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect and engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect and engineer.
12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
13. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 033000

SECTION 04 20 00

UNIT MASONRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements apply to the work of this section.

1.2 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to, the following:
 - 1. Clay brick masonry for exterior wall assemblies.
 - 2. Concrete masonry units for fire wall assemblies.
 - 3. Patching and repair of existing masonry were modified for construction of addition.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations for each material used. Provide certifications stating that materials comply with requirements. Indicate quantities of salvaged material to be reused.
- B. Verification Samples: Submit representative samples of each material that is to be used in the finished work, showing the full range of color and finish variations expected. Provide samples having minimum area of 144 square inches. Provide 6" long and 3/8" wide mortar color verification samples in square aluminum channels.
 - 1. If Contractor is able to obtain sufficient salvaged brick from selective demolition operations to complete the work, submission of samples will not be required. Obtain Architect's approval of salvaged materials prior to use.
- C. Test Reports: Submit certified reports for tests required.
- D. Shop Drawings: Provide complete, detailed drawings for fabrication of all components, special bricks and work. Show large scale details of sizes, profiles, reinforcing, anchors, ties and all other critical elements. Provide coordination drawings showing location of anchors and ties which must be built into other work.
 - 1. Indicate anticipated extent of cutting and patching of existing masonry walls. Field verify all opening dimensions.

1.4 INTENT

- A. A major intent of the work of this section is to provide watertight, weatherproof, strong, durable, attractive building skin systems. Patching and infill shall match existing construction as closely as possible.

PART 2 - PRODUCTS

2.1 BRICK MASONRY

- A. Brick: Provide face brick conforming to ASTM C216-07a, type FBS grade SW. Provide building brick conforming to ASTM C62. Use building brick only where concealed from view. Provide brick masonry having the following characteristics:
 - 1. Face Brick - Modular: Color/texture to be selected by Architect
 - 2. Shapes: Provide special shapes required by building configuration and as indicated on the Drawings. Never expose cores or unfinished surfaces.
- B. Salvaged Material: Wherever practical, utilize material salvaged from selective demolition operations for patching and repair of existing walls and transitions to new work.

2.2 CONCRETE MASONRY UNITS

- A. Provide hollow loadbearing concrete masonry units conforming to ASTM C90, type I, moisture controlled units. Provide solid loadbearing concrete masonry units conforming to ASTM C145. Provide concrete masonry having the following characteristics:
 - 1. Size, Standard Units: Provide units with nominal 8" by 16" face size by thickness indicated for 3/8" joints unless indicated otherwise. Provide thicknesses indicated, typically 8" or 12" nominal, or if not indicated, as necessary to create a properly supported, structurally safe wall built within the height to width limitations required by codes and recommended by the National Concrete Masonry Association.
 - 2. Shapes: Provide special shaped units for lintels, corners, jambs, headers, control joints and other conditions. Never expose cores.
 - 3. Grade: Provide grade N for all work.
 - 4. Weight: Provide normal weight units, except provide units with weight as standard with manufacturer for all units in fire-rated assemblies.
 - 5. Concrete Masonry Units for Fire-Resistive Construction: Provide concrete block for construction of fire-rated masonry block construction as listed by Underwriters' Laboratories, Inc. of Minimum Equivalent Thickness(es) defined and required by governing code.
 - 6. Provide half-blocks, lintel blocks, beam "U" blocks, other special blocks, and required special cutting. Provide jamb blocks, end blocks, control joint blocks, and lintel blocks with exposed ends closed.

2.3 MORTAR MATERIALS AND GROUT MATERIALS

- A. Provide preblended factory mix of Portland cement and hydrated lime, sand aggregate and color pigments as manufactured by Spec Mix Inc. or approved equal.
 - 1. Provide Type N mortar for exterior masonry above grade.
 - 2. Provide Type S mortar for reinforced and load bearing masonry, for masonry below grade and in contact with earth and elsewhere as indicated.
- B. Portland Cement: Complying with ASTM C150-07, type I, free from water soluble salts and alkalies. Provide cement that exhibits no efflorescence when tested in conformance with

standard efflorescence test, ASTM C 67, modified to use 2" x 7" x 2-1/2" mortar samples consisting of a mixture of 1 part by weight of cement under test and 2 parts of sand mixed to a flow of 100% with water. Provide cement color as necessary to provide mortar colors required by Architect. Two colors are required.

- C. Lime: ASTM C207-06, hydrated, type S.
- D. Grout Aggregate: Complying with ASTM C404-07.
- E. Mortar Aggregate: Complying with ASTM C144-04, fine.
- F. Mortar Pigment: Natural and synthetic oxides of iron and chrome, compounded for use in mortar. Use only pigments with proven record of satisfactory performance. Colors to match existing.
 - 1. Do not exceed pigment to mortar ratio of 1:10.
 - 2. At patching and repair of existing walls, match existing mortar color as closely as possible.
- G. Water: Clean and potable.
- H. Do not use admixtures or anti-freeze agents. Do not use masonry cement. Do not use calcium chloride or any compounds or mortar ingredients containing chlorides. Do not retemper mortar.

2.4 REINFORCING, TIES AND ANCHORS

- A. General: Provide brick anchors and ties as manufactured by Hohmann and Barnard Company, Heckman Building Products, or Wire Bond designed and engineered for the intended application.
- B. Thermal Seal Screw Veneer Tie for Metal Stud Construction: Reinforcing/Anchors: Provide Thermal 2-Seal Wing Nut Tie by Hohman Barnard or similar by approved manufacturers. Galvanized steel 3/16 in. Units consisting of a welded wire ladder section, welded eye plates and a veneer reinforcing bars.
 - 1. Dual-diameter barrel with factory-installed EPDM washers to seal both the face of the insulation and the air/vapor barrier (an extra large washer helps secure insulation to backup). Projecting Thermal Wings are steel reinforced and coated with highly flame resistant plastic to create a thermal break, decreasing thermal transfer through rigid insulation. The Wings accept a standard or seismic hook, spin to easily orient pintles/hooks to masonry joints, and provide up to 1/2" of adjustability to account for variations in wall thickness. Install with a standard 5/16" hex socket.
 - 2. Barrel (Stainless Steel): ASTM A580/A580M - AISI Type 304
 - 3. Screw (Carbon Steel): ASTM A510 (Carbon Steel) ASTM C954 (1000-hour polymer coating)
 - 4. Wire (Carbon Steel): Prefabricated from cold-drawn steel wire conforming to ASTM A1064
 - 5. Tensile Strength - 80,000 p.s.i. | Yield Point - 70,000 p.s.i. minimum
 - 6. Zinc Coating: Hot-Dip Galvanized after fabrication: ASTM A153 (1.5 oz/ft²)

- C. Masonry to Concrete Anchors: Provide minimum 24 gage steel dovetail slots and 1" wide, 16 gage galvanized steel corrugated anchors of length to suit wall conditions.
- D. Miscellaneous Ties: Provide hot-dip galvanized steel straps, bars, rods and similar items which are fabricated from not less than 16 gage sheet steel or 3/16" diameter steel wire.
- E. Reinforcing Steel: Provide deformed rebars complying with ASTM A615, Grade 60.
- F. Galvanizing: Provide hot-dip galvanized, ASTM A153, class B2, 1.5 oz/ft² nickel zinc coating on all ties, anchors and similar items which extend into an exterior wall assembly, except items of stainless steel. Semi-exposed areas shall be considered exterior. Hot-dip galvanize reinforcing.

2.4 MISCELLANEOUS MATERIALS

- A. Bond Breaker: 15 lb. roofing felt complying with ASTM D 226-06.
- B. Control Joints: Solid rubber strips with Shore A hardness of 60 to 80.
- C. Porous Mesh in Cavity: Mortar-Net or equal; 8" high in cavity and as indicated on the Drawings.
- D. Weeps: Open head joints, plastic sleeve not required.

2.6 BARRIERS, SHEATHING AND INSULATION

- A. Vapor and air barriers are specified in Section 07 27 26, Air and Vapor Barrier Membrane. Insulation material is specified in Section 07 21 00, Thermal Insulation.

2.7 CLEANING MATERIALS

- A. Provide chemical cleaning products, SureKlean 600 by ProSoCo Inc. or approved equal.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- A. Strictly comply with industry standards and recommendations of Brick Institute of America, National Concrete Masonry Association, and Prestressed Concrete Institute, except where more restrictive requirements are specified in this section. Beginning work means Installer accepts substrates and conditions.
 - 1. Allow sufficient setting time for mortar so that weight of work above does not cause lower work to bulge or creep prior to full set of mortar.
 - 2. Remove and replace with matching brick any spalled or otherwise damaged face brick.
- B. For unit masonry, lay masonry with bond patterns indicated on the Drawings and matching

existing. Provide expansion, control and isolation joints in masonry work where shown, or if not shown, at locations approved by Architect. Provide joints not more than 30' on center and in compliance with BIA recommendations as acceptable to the Architect.

- C. Tool joints concave as work proceeds in accordance with Architect's approved joint. Compress mortar to form a dense, smooth weathertight surface. Rake out mortar where sealants are shown to be installed.
- D. Lay masonry plumb and level with full bed and head joints, fully buttered and shoved into place. Do not slush joints. Keep cavity walls completely clear and free from projections and obstructions. Strike joints facing cavity flush. Prevent loose mortar from dropping into cavity.
- E. Grout units wherever shown and at all reinforcing, masonry lintels, bond beams, jambs and bearing points. Fully grout metal frames built into masonry work.
- F. For non-loadbearing work allow for deflection between top of walls and structure above. Maintain lateral stability in a manner acceptable to Architect and authorities having jurisdiction. Provide compressible fillers and joint sealers to maintain acoustical performance of wall assembly.
- G. Place porous mesh equal to Mortar-Net in wall cavity, 8" high in cavity.

3.2 REINFORCING, TIE, & ANCHOR INSTALLATION

- A. Provide reinforcing, ties and anchors for all work using the appropriate detailed or specified type for each condition. Ensure sufficient anchorage of brick wythe to back-up material to ensure deflection not to exceed $L/600$.
- B. Space wall ties to comply with codes and manufacturer's recommendations, but not less than one tie for each 2-2/3 sq. ft. of wall area, spaced a maximum of 16 inches on center vertically and horizontally and not more than 12" from any unsupported edge. Comply with requirements of Structural Drawings. Anchor ties securely to structural framing. Ties shall be fastened to metal stud back-up and not be fastened to sheathing only. Seal back of ties with mastic.

3.3 FLASHING INSTALLATION AND COORDINATION

- A. Flashings are specified in Section 07 60 00, Sheet Metal and Flashings; coordinate the installation with the masonry work.
- B. Prepare masonry surfaces to receive flashings smooth and free of projections. Place through-wall metal flashings on heavy bed of dampproofing mastic. Make sure that flashings are compatible with mastic used. Make sure that flashings are sealed and undamaged before covering with mortar.
- C. Provide flashing at every obstruction to the downward flow of water and where shown on the drawings. Fabricate and install flashing to control and divert water to the exterior. Form at least 8" high flashing above lintels and similar conditions to extend the entire length of the

intel. All flashing terminations shall have end dams.

- D. Coordinate and install reglets where indicated and where needed. Reglets are specified in Section 07 60 00, Sheet Metal and Flashings.

3.4 MASONRY REPAIR

- A. For unit masonry replacement, lay masonry with bond patterns matching existing.
- B. All edges of repair areas shall be square cut to clean faces of existing masonry units. Do not utilize feathered edges or partial unit replacements.
- C. Remove and replace work that is loose, chipped, broken or otherwise damaged. Eliminate all evidence of repair. Enlarge voids and holes in mortar joints and point with mortar to exactly match sound adjacent mortar.
- C. Where anchors or dowels have been cut and pieces remain embedded in the substrate: Anchors that are free of rust, solidly embedded, and do not project beyond the surface of the masonry unit may remain. All others should be removed. Install mechanical anchors to secure infill to existing.
- D. Clean all areas at perimeter of repair to remove any loose particles. Pre-wet the surface prior to placement of infill to prevent the substrate from drawing moisture out of the repair mortar too quickly.

END OF SECTION

SECTION 04 72 00

CAST STONE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this section.

1.2 DESCRIPTION OF WORK

- A. Provide cast stone sills, headers and trim, complete, to provide infill at existing masonry openings, as indicated on the Drawings and as specified herein.

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect Work of this Section. Other Specification Sections that directly relate to Work of this Section include, but are not limited to:
 - 1. Section 03 30 00, Cast-In-Place Concrete; Concrete backup.
 - 2. Section 04 20 00, Unit Masonry.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A firm experienced in manufacturing cast stone units similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to manufacture required units. Source Limitations for Cast Stone: Obtain cast stone units through one source from a single manufacturer
- B. Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
- C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color, from one manufacturer for each cementitious component and from one source or producer for each aggregate.
- D. Installer shall be a firm which has successfully installed stonework for comparable project for a period of not less than five years.

1.6 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for cast stone units.
- B. Shop Drawings: Show fabrication and installation details for cast stone units. Include dimensions; details of reinforcement and anchorages, if any; and indication of finished faces. Provide field verified dimensions of openings.

1.7 TESTING

- A. The Owner reserves the right to have tests made of mortar materials and mortar, at his option, as the job progresses, as specified in Section 01 45 00, Quality Control and Testing Services. Tests will be performed by a recognized Testing Laboratory, selected by the Architect, with all costs paid by the Owner. The Contractor shall agree to abide by the results of the tests; he shall make all adjustments and changes to mortar and materials to meet the specification requirements at no additional cost to the Owner.

1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Protect cast stone during delivery, storage and construction against moisture, soiling, staining, and physical damage.
- B. Handle cast stone to prevent chipping, breakage, staining and other damage. Do not use pinch or wrecking bars without protecting edges of stone with wood or other rigid materials. Lift with wide-belt slings wherever possible; do not use wire rope or ropes containing tar or other substances which might cause staining. If required, use wood rollers and provide cushion at end of wood slides.
- C. Store cast stone on wood skids or pallets, covered with nonstaining, waterproof membrane. Place and stack skids and cast stone to distribute weight evenly and to prevent breakage or cracking. Protect stored cast stone from weather with waterproof, nonstaining covers or enclosures, but allow air to circulate.
- D. Protect mortar materials and accessories from weather, moisture and contamination with earth and other foreign materials.

PART 2 PRODUCTS

2.1 CAST STONE - GENERAL

- A. Cast Stone shall have a honed limestone texture and match Architect's color samples.
- B. Cast Stone shall be as manufactured by Accurate Precast Corp., Brooklyn, NY or approved equal.

- C. Characteristics:
 - 1. Arrises shall be sharp and clear. Nosings eased as shown on Drawings.
 - 2. Exposed surfaces, unless otherwise specified, shall exhibit a typically fine grained texture similar to natural stone. No bug holes will be permitted, and all facing material shall be mixed in a muller mixer.

2.2 MATERIALS

- A. Cement shall be Portland Type I or Type III white and/or gray meeting ASTM C 150.
- B. Fine aggregate shall be carefully graded and washed natural sands, or manufactured granite, marble, quartz or limestone sands meeting ASTM C 33, except that gradation may vary to achieve desired finish and texture.
- C. Coarse aggregate shall be carefully graded and washed natural gravels, or crushed graded stone such as granite, marble, quartz, limestone or other durable stone meeting ASTM C 33, except that gradation may vary to achieve desired finish and texture..
- D. Color: All colors added shall be inorganic (natural or synthetic) iron oxide pigments meeting ASTM C 979 excluding the use of a cement grade of carbon black pigment, and shall be guaranteed by the pigment manufacturer to be sunfast and lime-proof. The amount of pigment shall not exceed 10% by weight of the cement used.
- E. Cast Stone shall have a minimum compressive strength of 5000 psi when tested on 6 in. cylinders or 6500 psi when tested on 2 in. x 2 in. cubes. Absorption shall not exceed 6% by weight.
- F. Cast Stone shall be reinforced with new billet steel reinforcing bars meeting ASTM A 615, grade 40 or grade 60, when necessary for safe handling, setting and structural stress, and the size of the reinforcing shall be specified. Reinforcement shall be galvanized when covered with less than 2 inches of material for bars larger than 5/8 in. and 1-1/2 in. for bars 5/8 in. or smaller. The material covering in all cases shall be at least twice the diameter of the bars.
- G. Anchors, dowels and other anchoring, connecting and supporting devices shall be furnished by the stone setter as shown on approved Shop Drawings using, whenever possible, standard building stone anchors commercially available in a non-corrosive material. Stainless Steel Type 302 or 304.
- H. Bearing pads shall be high grade synthetic neoprene rubber with a durometer hardness of at least 70.
- I. Pointing mortar shall be composed of 1 part non-staining cement ASTM C 91, 1 part hydrate lime conforming to ASTM C 207, Type S and 4 parts of clean, washed sand conforming to ASTM C 144. Coloring pigments may be added as required. The Architect will approve color of pointing mortar before proceeding with pointing.

2.3 FABRICATION

- A. General: Fabricate cast stonework as shown and as detailed on final shop drawings.
- B. Beds and Joints: Pieces shall be bedded and jointed as shown on the approved shop drawings, and bed joint and vertical joint surfaces shall be cut with 3/16 in. beds and joints, as indicated on the approved shop drawings.
- C. Holes, cut-outs, sinkages and openings in granite work for anchors, cramps, dowels, supports, and lifting devices, shall be accurately cut or drilled to required dimensions, as shown on the approved shop drawings, and as necessary to secure cast stone in place to insure correct location and accurate fit. Setting beds shall be shaped to fit supports.
- D. Arrises shall be cut sharp and true to square, and continuous with adjoining arrises. Where exposed, arrises shall be eased. Nosings shall match profiles shown on Drawings.

PART 3 EXECUTION

3.1 SETTING

- A. Set cast stone in accordance with Drawings and approved Submittals. Provide anchors, supports, fasteners and other attachments shown or necessary to secure stonework in place. Shim and adjust accessories for proper setting of stone. Completely fill holes for anchors and dowels with mortar during setting of stone.
- B. Cast stone shall not be dropped upon or slid over masonry, nor shall hammering or turning of stones on the masonry be allowed. Stones shall be carefully set without jarring the stone already laid, and they shall be handled with a lewis or other appliance which will not cause disfigurement.
- C. No pinning up of stones with spalls will be permitted and no spalls will be permitted in beds.
- D. Joints shall be completely filled with mortar and shall then be raked out to one-third the depth of the stone or 1", whichever is less. Raked joints shall be brushed clean, wetted thoroughly before applying fresh mortar, and pointed with mortar as directed by Architect.
 - 1. Joints and grout shall be uniform in appearance, texture and color.
 - 2. After initial set of grout, joints shall be tooled with rounded non-staining jointing tool to produce glassy, hard polished, slightly concave joint.
 - 3. Completed joints shall be smooth and free of cracks.

3.2 ADJUST AND CLEAN

- A. Remove and replace cast stone units that are broken, chipped, stained, or otherwise damaged. Where directed, remove and replace units that do not match adjoining stonework. Provide new matching units, install as specified, and point joints to eliminate evidence of

replacement. Repoint defective and unsatisfactory joints as required to provide a neat, uniform appearance.

- B. Clean cast stone no less than six days after completion of work, using clean water and stiff-bristle brushes. Do not use wire brushes, acid type cleaning agents, or other cleaning compounds containing caustic or harsh fillers.

END OF SECTION

SECTION 05 12 00

STRUCTURAL STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.
- B. General Notes, Sections, Plans, Typical Details, and other notes indicated on the structural drawings. In cases of conflict, information indicated on the structural drawings shall govern.

1.2 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC's "Code of Standard Practice for Steel Buildings and Bridges," that support design loads.

1.3 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using schematic details indicated and AISC's "Manual of Steel Construction"
 - 2. Engineering Responsibility: Fabricator's responsibilities include using a qualified professional engineer to prepare structural analysis data for structural-steel connections.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment drawings.
 - 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.
 - 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.

5. For structural-steel connections indicated to comply with design loads, include structural analysis data prepared by the qualified professional engineer responsible for their preparation.
- C. Welding certificates.
- D. Qualification Data: For Installer and fabricator.
- E. Mill Test Reports: Signed by manufacturers certifying that the following products comply with requirements:
 1. Structural steel including chemical and physical properties.
 2. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 3. Shop primers.
- F. Source quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- B. Fabricator Qualifications: A qualified fabricator who participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category Sbd.
- C. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."
- D. Comply with applicable provisions of the following specifications and documents:
 1. AISC's "Code of Standard Practice for Steel Buildings and Bridges."
 2. AISC's "Specification for Structural Steel Buildings."
 3. AISC's "Specification for the Design of Steel Hollow Structural Sections."
 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from erosion and deterioration.
 1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
 2. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.7 COORDINATION

- A. Furnish anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: As noted on structural drawings.
- B. Channels, Angles, M, S-Shapes: As noted on structural drawings.
- C. Plate and Bar: As noted on structural drawings.
- D. Cold-Formed Hollow Structural Sections: As noted on structural drawings.
- E. Other: As noted on structural drawings.
- F. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: As indicated on structural drawings
 1. Nuts: ASTM A 563 heavy hex carbon-steel nuts;
 2. Plate Washers: ASTM A 36/A 36M carbon steel.
 3. Washers: ASTM F 436 hardened carbon steel.
- B. Headed Anchor Rods: As noted on structural drawings.
 1. Nuts: ASTM A 563 heavy hex carbon steel.
 2. Plate Washers: ASTM A 36/A 36M carbon steel.
 3. Washers: ASTM F 436 hardened carbon steel.

2.3 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer.
- B. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20 ASTM A 780.

2.4 GROUT

- A. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404, Size No. 2. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC's "Specification for Structural Steel Buildings."
 - 1. Camber structural-steel members where indicated.
 - 2. Identify high-strength structural steel according to ASTM A 6/ A 6M and maintain markings until structural steel has been erected.
 - 3. Mark and match-mark materials for field assembly.
 - 4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Holes: Provide holes required for securing other work to structural steel and for passage of other work through steel framing members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Base-Plate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: As indicated on structural drawings
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 2. Surfaces to be field welded.
 3. Surfaces to receive sprayed fire-resistive materials.
 4. Galvanized surfaces.
- B. Painting: Apply a 1-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.

2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/ A 123M.
1. Fill vent holes and grind smooth after galvanizing.
 2. Galvanize lintels attached to structural-steel frame and located in exterior walls.

2.9 SOURCE QUALITY CONTROL

- A. Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:
1. Liquid Penetrant Inspection: ASTM E 165.
 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 3. Ultrasonic Inspection: ASTM E 164.
 4. Radiographic Inspection: ASTM E 94.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments, with steel erector present, for compliance with requirements.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place, unless otherwise indicated.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings."
- B. Base and Bearing Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.
 - 1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of base plate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and base or bearing plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
- E. Do not use thermal cutting during erection.
- F. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened, unless noted otherwise on structural drawings.
- B. Weld Connections: Comply with AWS D1.1 for welding procedure specifications, tolerances, appearance, and quality of welds and for methods used in correcting welding work.
 - 1. Comply with AISC's "Code of Standard Practice for Steel Buildings and Bridges" and "Specification for Structural Steel Buildings" for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Shop-bolted connections will be inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.
 - 1. In addition to visual inspection, field welds will be tested according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- D. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

- A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists and accessories, bearing plates, and abutting structural steel.

1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.
- C. Touchup Painting: Cleaning and touchup painting are specified in Division 9 painting Sections.

END OF SECTION 051200

SECTION 053100

STEEL DECKING

PART 1 – GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.
- B. General Notes, Sections, Plans, Typical Details, and other notes indicated on the structural drawings. In cases of conflict, information indicated on the structural drawings shall govern.

1.2 SUMMARY

- A. This Section specifies steel decking and its attachment to the main building structure.
- B. Sustainable Design Intent: Comply with project requirements intended to achieve sustainable design, measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to Section 018110, SUSTAINABLE DESIGN REQUIREMENTS for certification level and certification requirements.

1.3 SUBMITTALS

- A. Product Data: For each type of deck, accessory and product indicated.
- B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories and attachments to other construction.
- C. Product Certificates: For each type of steel deck, signed by product manufacturer.
- D. Welding certificates.
- E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements.
 - 1. Power-actuated mechanical fasteners.
- F. Research/Evaluation Reports: For steel deck

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.
- B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code – Sheet Steel."
- C. Fire-Test Response Characteristics: Where indicated, provide steel deck units identical to those tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.
 - 1. Fire-Resistance Ratings: Indicated by design designations of applicable testing and inspecting agency.
 - 2. Steel deck units shall be identified with appropriate markings of applicable testing and inspecting agency.
- D. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members".

1.5 DELIVERY, STORAGE AND HANDLING

- A. Protect steel deck from corrosion, deformation and other damage during delivery, storage and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Steel Deck:
 - a. Nucor Corp.; Vulcraft Division
 - b. New Millennium Building Systems
 - c. Canam-Buildings

2.2 ROOF DECK

- A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with “SDI Specifications and Commentary for Steel Roof Deck”, in SDI Publication No. 30, and with the following:
 - 1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS).
 - 2. Steel Grade: As indicated on structural drawings
 - 3. Galvanized Coating Rating: As indicated on structural drawings
 - 4. Deck Gauge: As indicated on structural drawings
 - 5. Deck Profile: As indicated on structural drawings
 - 6. Profile Depth: As indicated on structural drawings
 - 7. Design Uncoated-Steel Thickness: As indicated on structural drawings
 - 8. Span Condition: Triple span or more.
 - 9. Side Laps: Overlapped.

2.4 ACCESSORIES

- A. General: Provide manufacturer’s standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, or same material and finish as deck; of profile indicated or required for application.
- E. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated or as recommended by SDI Publication No. 30 for overhang and slab depth.
- F. Column Closures, End Closures, Z-Closures and Cover Plates: Steel sheet, of same material, finish and thickness as deck, unless otherwise indicated.
- G. Galvanizing Repair Paint: ASTM A 780 SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94 percent zinc dust by weight.

PART 3 – EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:
 - 1. Weld Spacing: As indicated on structural drawings
 - 2. Weld Diameter: As indicated on structural drawings
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports as indicated on structural drawings
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum.

D. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 40 00

COLD FORMED METAL FRAMING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this section.

1.2 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to, the following:
 - 1. Metal framing for lateral support of exterior wall systems. Include incidental blocking, bridging and related accessories for items supported in or by framing as required by project conditions.

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to:
 - 1. Section 01 45 00, Quality Control.
 - 2. Section 01 43 39, Mock-Ups; Requirements for mock-ups.
 - 3. Section 01 33 00 Submittal Procedures

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, use limitations, and recommendations for each material used. Provide certifications stating that materials comply with requirements.
- B. Shop Drawings: Provide large scale shop drawings for fabrication, installation and erection of all parts of the work. Provide plans, elevations, and details of anchorages, connections and accessory items. Provide installation templates for work installed by others.
 - 1. Shop drawings shall illustrate materials, shop coatings, steel thicknesses, details of fabrication, details of attachment to adjoining work, size, location, and spacing fasteners for attaching framing to itself, details of attachment to the structure, accessories and their installation, and critical installation procedures.
- C. Field Measurements: Take accurate field measurements before preparation of shop drawings and fabrication. Do not delay job progress; allow for field cutting and fitting where taking

field measurements before fabrication is not possible. Do not field cut or fit items which have been hot-dip galvanized after fabrication.

- D. Calculations: Provide professionally prepared calculations and certification of the performance of this work. Show how design load requirements and other performance criteria have been satisfied.

1.5 QUALITY ASSURANCE

- A. Engineering: Provide the services of a Professional Engineer, who is legally qualified to practice in State of New York and who is experienced in providing engineering services of the kind indicated, to design and certify that the work of this section meets or exceeds the performance requirements specified in this section. Calculate structural properties of studs and assemblies in accordance with American Iron and Steel Institute (AISI) "Specification for Design of Cold-Formed Steel Structural Members."
 - 1. Deflection criteria for studs only at code required loading shall be $L/360$ for metal panels. $L/720$ for masonry panels.
 - 2. All connections including member to member, and member to structure shall be designed.
 - 3. Wall bridging shall be designed to provide resistance to minor axis bending and rotation of wall studs.
- B. Shop fabricate work to the greatest extent possible. Clearly label pieces in shop to facilitate field assembly.
- C. Use qualified welders and comply with American Welding Society (AWS) D1.3, "Structural Welding Code - Sheet Steel."
- D. Materials which are rusted, dented, bent or twisted shall be removed from the job site immediately.
- E. Mock-Up: Mock-up of exterior wall including cold-formed metal framing is required. Comply with requirements of Section 01 43 39, Mock-Ups.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Store work off of the ground and under cover. Protect from damage. Sequence deliveries to avoid delays, but minimize on-site storage.
- B. Store materials on a flat plane.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide cold formed metal framing manufactured by Marino Ware, Clark Dietrich, or Architect approved equal. Provide 8 inch deep studs at metal panels unless indicated otherwise.
- B. System Components: Manufacturer's standard load-bearing steel studs, joists, and furring of type, size, shape, and gage as indicated. With each type of metal framing required, provide manufacturer's standard steel runners (tracks), blocking, lintels, clip angles, shoes, reinforcements, fasteners, and accessories for applications indicated, as needed to provide a complete metal framing system.
- C. Materials and Finishes: As required for design criteria. Provide minimum 42 mil (.0428 inch) or heavier for anchor tie screws. Refer to Drawings for sizes and spacing.
 - 1. Fabricate metal framing components of structural quality steel sheet with a minimum yield point of 40,000 psi; ASTM A 653 (2007) or ASTM A 1008.
 - 2. Fasteners: Provide nuts, bolts, washers, screws, and other fasteners with corrosion-resistant plated finish equivalent to cadmium plating, ASTM A165, Type NS.
 - 3. Electrodes for Welding: Comply with AWS Code and as recommended by stud manufacturer.
- D. Metallic Coating/Galvanizing: G60 (Z180), ASTM A1003.

2.2 FABRICATION

- A. General: Framing components may be prefabricated into assemblies before erection. Fabricate panels plumb, square, true to line, and braced against racking with joints welded. Perform lifting of prefabricated units to prevent damage or distortion.
- B. Fabricate units in jig templates to hold members in proper alignment and position and to assure consistent component placement.
- C. Fastenings: Attach similar components by welding. Attach dissimilar components by welding, bolting, or screw fasteners, as standard with manufacturer.
- D. Wire tying of framing components is not permitted.
- E. Fabrication Tolerances: Fabricate units to a maximum allowable tolerance variation from plumb, level, and true to line of 1/8 inch in 20 feet.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install metal framing systems in accordance with manufacturer's printed or written instructions and recommendations.
- B. Runner Tracks: Install continuous tracks sized to match studs. Align tracks accurately to layout at base and tops of studs. Secure tracks as recommended by stud manufacturer for type of construction involved, except do not exceed 24 inches o.c. spacing for nail or power-driven fasteners or 16 inches o.c. for other types of attachment. Provide fasteners at corners and ends of tracks.
- C. Installation of Wall Studs: Secure studs to top and bottom runner tracks by either welding or screw fastening at both inside and outside flanges unless vertical slip joint is required.
- D. Set studs plumb, except as needed for diagonal bracing or required for non-plumb walls or warped surfaces and similar requirements.
- E. Where stud system abuts structural columns or walls, including masonry walls, anchor ends of stiffeners to supporting structure.
- F. Install supplementary framing, blocking, and bracing in metal framing system wherever walls or partitions are indicated to support fixtures, equipment, services, casework, heavy trim and furnishings, and similar work requiring attachment to the wall or partition. Where type of supplementary support is not otherwise indicated, comply with stud manufacturer's recommendations and industry standards in each case, considering weight or loading resulting from item supported.
- G. Frame wall openings larger than 2 feet square with double stud at each jamb of frame except where more than two are either shown or indicated in manufacturer's instructions. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with stud shoes or by welding, and space jack studs same as full-height studs of wall. Secure stud system wall opening frame in manner indicated.
- H. Frame both sides of expansion and control joints with separate studs; do not bridge the joint with components of stud system.
- I. Install horizontal stiffeners in stud system, spaced (vertical distance) at not more than 54 inches o.c. Weld at each intersection.
- J. Erection Tolerances: Bolt or weld wall panels (at both horizontal and vertical junctures) to produce flush, even, true-to-line joints.
 - 1. Maximum variation in plane and true position between prefabricated assemblies should not exceed 1/16 inch.

- K. Reinforce ends with end clips, steel hangers, steel angle clips, steel stud section, or as otherwise recommended by joist manufacturer.
- L. Holes that are field cut into steel framing members shall be within limitations of the product and its design. Provide reinforcement where holes are cut through load-bearing members in accordance with manufacturer's recommendations.
- M. Purlins shall be installed with their web area perpendicular to the bearing surface. Bridging, either steel strap or solid, shall be provided as indicated on the shop drawings.
- N. Provide additional framing around all roof openings as noted on the shop drawings.
- O. End blocking shall be provided where purlin ends are not otherwise restrained from rotation. All bridging, bracing, blocking, strapping, web reinforcement shall be in place prior to further loading.
- P. Steel drill screws shall be of the minimum diameter indicated by the design of that particular attachment detail on the shop drawings. Penetration through joined materials shall not be less than 3 exposed threads.
- Q. Field Painting: Touch-up damaged shop-applied protective coatings. Use galvanizing repair system for galvanized surfaces.
 - 1. All screw penetrations of metal framing system supporting exterior wall construction shall be spray painted with an Architect approved zinc-rich paint prior to closing walls. Apply from the interior side.

3.2 TOLERANCES

- A. Provide alignment of within 1/8 in. in 10 ft of proper location.
- B. Spacing of purlins shall not be more than plus or minus 1/8 in. from the designed spacing providing that the cumulative error does not exceed the requirements of the finishing materials.

3.3 INSPECTIONS

- A. Inspections shall be performed to assure strict conformance to the shop drawings. All members shall be checked for proper alignment, bearing, completeness of attachments, proper alignment and reinforcement. Inspections where and as required by local codes shall be controlled inspections.

3.4 REPAIRING, CLEANING, AND PROTECTION

- A. Touch-up damaged coatings and finishes to eliminate evidence of repair.

- B. Repair minor damage to eliminate all evidence of repair. Remove and replace work which cannot be satisfactorily repaired.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this section.

1.2 DESCRIPTION OF WORK

- A. The work of this Section includes, but is not limited to:
 - 1. Miscellaneous bearing and leveling plates.
 - 2. Loose steel lintels.
 - 3. Wall brackets for furnishing and casework support.
 - 4. Roof access ladders.

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to:
 - 1. Section 03 30 00, Cast-In-Place Concrete.
 - 2. Section 05 12 00, Structural Steel.

1.4 QUALITY ASSURANCE

- A. Engineering: Provide the services of a Professional Engineer, who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated, to design and certify that the work of this section meets or exceeds the performance requirements specified in this section.
- B. Shop fabricate work to the greatest extent possible. Clearly label pieces in shop to facilitate field assembly.
- C. Perform welding in compliance with American Welding Society Code. Shop weld and grind connections to the greatest extent possible.

1.5 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, use limitations,

and recommendations for each material used. Provide certifications stating that materials comply with requirements.

- B. Shop Drawings: Provide large scale shop drawings for fabrication, installation and erection of all parts of the work. Provide plans, elevations, and details of anchorages, connections and accessory items. Provide installation templates for work installed by others.
- C. Field Measurements: Take accurate field measurements before preparation of shop drawings and fabrication. Do not delay job progress; allow for field cutting and fitting where taking field measurements before fabrication is not possible. Do not field cut or fit items which have been hot-dip galvanized after fabrication.
- D. Calculations: Provide professionally prepared calculations and certification of the performance of this work. Show how design load requirements and other performance criteria have been satisfied.
- E. Samples: Submit samples of all types of exposed welded connections, ground smooth, dressed, and primed for Architect's review and approval.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Store work off of the ground and under cover. Protect from damage. Maintain shop applied primer coatings until finish painting is complete. Sequence deliveries to avoid delays, but minimize on-site storage.

1.7 PROJECT CONDITIONS

- A. Do not permit use of stairs, ladders, handrails, guardrails or other work until work is completely and fully installed and ready to assume its intended design loads. Do not permit overloading of any miscellaneous metal system. Do not permit use of concrete filled metal pan stair systems before concrete is placed and cured.

PART 2 - PRODUCTS

2.1 MATERIALS AND PRODUCTS

- A. Steel Shapes: ASTM A36.
- B. Steel Tubing: ASTM A500, cold-formed.
- C. Steel Sheet: ASTM A1008, of grade required for design loading.
- D. Steel Pipe: ASTM A53, black schedule 40, unless indicated otherwise. Type and grade as required for design loading.
- E. Aluminum Plate and Sheet: ASTM B209-07, Alloy 6061-T6.

- F. Aluminum Extrusions: ASTM B 221-06, alloy 6063-T6, extrusions suitable for service intended.
- G. Stainless Steel Sheet, Strip, Plate and Flat Bars: ASTM A 666-03, AISI Type 304, non-corrosive; AISI No. 4 finish.
- H. Stainless Steel Bars and Shapes: ASTM A 276-06, Type 304.
- I. Iron Castings: ASTM A47 or A48, grade and class are manufacturer's option.
- J. Grout: Pre-mixed, non-staining, non-corrosive, non-shrink, non-metallic complying with CE CRD-C588, type D.
- K. Bolts and Fasteners: ASTM A307 and other types as appropriate and approved by Architect.
- L. Comply with the latest edition of the following standards:
 - 1. AISI Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.
 - 2. AISC Code of Standard Practice for Steel Buildings and Bridges.
 - 3. AWS Code for Welding in Building Construction.
 - 4. Specifications for Structural Joints using ASTM A325-07a or A490-08a Bolts, Research Council on Riveted and Bolted Structural Joints of Engineering Foundation.
 - 5. SSPC Painting Manual, Vol. 1 - Good Painting Practice and Vol. 2 - Systems and Specifications.
 - 6. Fed. Specs QQ-I-652A, Iron Gray Castings: QQ-S-741A, Steel Plates, Shapes and Bars, Carbon, Structural; WW-P-521, Malleable Iron.

2.2 FABRICATION

- A. General Fabrication: Fabricate work to be truly straight, plumb, level and square and to sizes, shapes, and profiles indicated on approved shop drawings. Ease exposed edges. Cut, reinforce, drill and tap metalwork as necessary for proper assembly and use.
 - 1. Fabricate all miscellaneous metal supports, brackets, braces and the like required to fully complete the work of this project.
 - 2. Coordinate miscellaneous metal requirements with other specification sections to ensure proper interface of various parts of the work.
 - 3. Obtain loading requirements from suppliers of work to be supported and design and fabricate support systems with factor of safety of at least 6.
- B. Work Exposed To View: Take special care in choosing materials that are smooth and free of blemishes such as pits, roller marks, trade names, scale and roughness. Fabricate work with uniform, hairline tight joints. Form welded joints and seams continuously and grind flush and smooth to be invisible after painting. Fillet welds will not be accepted; plug welds and flush welds are required. For exposed fasteners, use hex head bolts or Phillips head machine screws.

- C. Painting & Preparation, Exposed Steel: Prime paint all work not indicated to be galvanized. Prepare work for shop priming in compliance with Steel Structures Painting Council SP-6 *Commercial Blast Cleaning*. Provide 1 mil dry film thickness of rust inhibitive primer specified in Section 09910 - Painting. Provide two coats with two mils total dry film thickness for surfaces which are inaccessible after assembly or erection.
- D. Painting & Preparation, Miscellaneous Metals Concealed From View: Prime paint all work not indicated to be galvanized. Prepare work for shop priming by power tool cleaning. Provide 1 mil dry film thickness of rust inhibitive primer specified in Section 09910 - Painting. Provide two coats with two mils total dry film thickness for surfaces which are inaccessible after assembly or erection.
- E. Bearing and Leveling Plate Fabrication: Design and fabricate plates for steel and wood members bearing on masonry or concrete. Provide flat, uniform bearing areas of size and thickness required for loading conditions encountered. Use standard AISC and AITC design criteria. Drill plates as necessary to receive anchor bolts and for grouting access. Units in exterior wall construction shall be hot dip galvanized.
- F. Loose Steel Lintel Fabrication: Fabricate lintels from angles or shapes for openings, recesses in walls, where shown, and elsewhere where needed. Provide for minimum of 8 in. bearing at each end. Weld individual angles or shapes together to form composite members where indicated or required.
- G METAL LADDERS
 - 1. General: Comply with ANSI A14.3.
 - 2. Steel Ladders:
 - a. Space siderails 18 inches apart unless otherwise indicated.
 - b. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
 - c. Rungs: 1-inch diameter deformed steel bars.
 - d. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
 - e. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
 - f. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
 - g. Galvanize and prime ladders, including brackets.
 - h. Paint ladders as indicated in Section 09 91 00.

2.3 FINISHING

- A. General: Shop prime work to greatest extent possible, except those items indicated to be embedded in concrete, and those items indicated to receive fireproofing. Field touch-up shop applied coatings after installation.
- B. Prepare work for shop priming in compliance with SSPC SP6.
- C. Provide 1 mil dry film thickness of rust inhibitive primer over properly prepared, non-galvanized and/or non-fireproofed surfaces. Provide two coats with 2 mils total dry film

thickness for surfaces which are inaccessible after assembly or erection.

- D. Primer for Non-Galvanized Ferrous Surfaces (except interior handrail and railing assemblies and interior steel stairs): Provide high-quality, lead-free, rust-inhibitive primer, equal to one of the following:
1. Series 10 Metal Primer, Tnemec.
 2. Bar-ox Quick Dry Universal Primer; Devoe and Raynolds.
 3. Ironclad Retardo; Benjamin Moore.

PART 3 - EXECUTION

3.1 INSTALLATION/ERECTION

- A. Provide suitable anchors and fasteners to connect miscellaneous metal items to other construction. Provide setting templates and diagrams and coordinate with other work so that adequate anchor bolts, blocking and bracing is in place and accurately located. Beginning work means Installer accepts substrates and conditions.
- B. Set work accurately and truly plumb, level and aligned. Make field assembly and connections with the same level of quality as shop fabricated work.
- C. Miscellaneous Bearing and Leveling Plates: Clean concrete and masonry surfaces of bond reducing materials. Roughen surfaces if required to improve bond to surface. Clean bottom surface of leveling plates immediately prior to installation.
1. Set loose leveling and bearing plates on wedges or other adjustable devices. Tighten anchor bolts after plates have been positioned plumb and level. Pack voids between plates and bearing surfaces solidly with specified grout.
- D. Loose Steel Lintels: Furnish loose steel lintels required at masonry openings throughout project to Masonry trade for installation. Provide as scheduled on Structural Drawings.
- E. Miscellaneous Framing and Supports: Install framing and support to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings. Anchor supports securely to and rigidly brace from building structure.

3.2 TOLERANCES

- A. The following allowable installed tolerances are allowable variations from locations and dimensions indicated by the Contract Document and shall not be added to allowable tolerances indicated for other work.
1. Allowable Variation from True Plumb, Level and Line: $\pm 1/8"$ in 20'-0".

3.3 REPAIRING, CLEANING, & PROTECTION

- A. Touch-up damaged coatings and finishes to eliminate evidence of repair.
- B. Repair minor damage to eliminate all evidence of repair. Remove and replace work which cannot be satisfactorily repaired.

END OF SECTION

SECTION 06 10 00

ROUGH CARPENTRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this section.

1.2 DESCRIPTION OF WORK

- A. The work of this Section includes, but is not limited to:

- 1. Concealed blocking, grounds and nailers.
- 2. Backing panels at utility closets.
- 3. Blocking for casework support.

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to:
 - 1. Section 05 50 00, Metal Fabrications
 - 2. Section 06 40 23, Interior Architectural Woodwork
 - 3. Section 09 21 16, Gypsum Board Assemblies; sheet metal blocking.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations for each material used. Provide certifications stating that materials comply with requirements.
- B. Treatment Data: For each type of treatment required provide manufacturer's certification stating chemicals and process used, quantities of chemicals retained, conformance with applicable standards, and certification that moisture content after treatment was reduced to maximum specified.

1.5 STORAGE AND HANDLING

- A. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from moisture and damage. Stack materials to promote air circulation.
- B. Sequence deliveries to avoid delays, but to minimize on-site storage.

1.6 PROJECT CONDITIONS

- A. Coordinate work of this section with work of other sections to ensure proper location and attachment of other work. Scribe and trim work to provide accurate fit.

PART 2 - PRODUCTS

2.1 LUMBER

- A. Provide construction grade blocking, furring, sleepers and similar items of any species complying with PS 20. Provide above ground lumber not at building interior and in contact with roofing, flashing, sheet metal, masonry, concrete, dampproofing and waterproofing that is pressure treated with waterborne preservatives complying with AWPB LP-2 and AWPB C2. Dry lumber to maximum moisture content of 15% after treatment.
 - 1. All concealed wood and lumber within the building shall be fire-retardant treated. Provide treatment that yields a flame spread rating of not more than 25 when tested according to ASTM E84. Kiln dry after treatment to maximum moisture content of 19%. Do not use fire-retardant treatments containing ammonium phosphates or salts.
 - 2. Provide factory markings on each piece of lumber.

2.2 PLYWOOD

- A. For backing panels at utility closets, provide APA trademarked, UL labeled, fire-retardant treated, C-D Plugged Exposure 2 panels 3/4" thick unless noted otherwise, and complying with PS 1. Provide treatment that yields a flame spread rating of not more than 25 when tested according to ASTM E84. Kiln dry after treatment to maximum moisture content of 19%. Do not use fire-retardant treatments containing ammonium phosphates or salts.

2.3 MISCELLANEOUS MATERIALS

- A. Inserts, Anchors, and Fasteners: Provide inserts, anchors, anchor bolts, lag bolts, screws, washers, nuts, nails, and other rough hardware. Assist other trades as necessary in the placement of inserts and anchor bolts in concrete and masonry. Furnish full instructions regarding locations, sizes, and other requirements to ensure proper preparation. Provide rough hardware which complies with requirements of the governing laws and codes.
 - 1. All fasteners (i.e. bolts, anchor rods, lag bolts, nails, screws, etc.) in direct contact with Chromated Copper Arsenate (CCA-C), Sodium Borate (SBX), Alkaline Copper Quat (ACQ-C & ACQ-D), Copper Azole (CBA-A & CA-B) OR SBX w/ NaSiO₂ preservative treated lumber shall have Hot Dipped Galvanized (G135 HDG per ASTM A653) finish or approved equal. All Fasteners in contact with any other type of preservative treatment shall be fabricated from Type 306 or Type 316 stainless steel.
- B. Rough Hardware: Provide hot-dip galvanized steel finish or stainless steel finish for rough hardware items for use at exterior. Hot dip galvanizing shall be in accordance with ASTM A 153. Provide other concealed items cadmium plated or zinc chromate plated.

- C. Provide non-impact drilled anchors and fasteners for securing wood framing, blocking or plywood into masonry or concrete of sufficient length to penetrate the receiving member a minimum of 1-1/2 in.

PART 3 - EXECUTION

3.1 INSPECTION

- A. The Installer/Erector shall examine substrates, supports, and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means Installer accepts substrates and conditions.

3.2 INSTALLATION/ERECTION

- A. Strictly comply with referenced standards, except where more restrictive requirements are specified in this section. Choose pieces carefully to eliminate split, warped and twisted members.
- B. Securely anchor work to substrates and structure. Ensure that blocking is capable of supporting applied work and loadings. Countersink bolts and other fasteners flush with face of wood.

END OF SECTION

SECTION 06 16 43

GYPSUM SHEATHING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this section.

1.2 DESCRIPTION OF WORK

- A. The work of this Section includes, but is not limited to:
 - 1. Exterior gypsum sheathing.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, MSDS sheets, use limitations and recommendations for each material used. Provide certifications stating that materials comply with requirements.

PART 2 - PRODUCTS

2.1 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:
 - 1. Georgia-Pacific Corp.
 - 2. United States Gypsum Co.

2.2 SHEATHING

- A. Wall Sheathing: ASTM C 1177 with glass mats both sides and long edges, water-resistant treated core or ASTM C 1278 with water resistant core; face and back surface water resistant coatings:
 - 1. Manufacturer: Dens-Glass Gold Exterior Sheathing by G-P Gypsum Corporation or Fiberock Aqua Tough Exterior Sheathing by USG.
 - 2. Thickness: 5/8 inches thick.
 - 3. Fire Resistance: ASTM E 136, non-combustible; ASTM E 84, flame spread 0, smoke developed 0.

2.3 MISCELLANEOUS MATERIALS

- A. Screws for Fastening Sheathing to Cold-Formed Metal Framing: Type S, Bugle head, rust-resistant sharp point. DUROCK Brand Steel or USG Sheathing SF steel drill screws 1-1/4 inch with corrosion-resistant coating.
 - 1. For steel framing less than 0.0329 inch thick, attach sheathing to comply with ASTM C 1002.
 - 2. For steel framing from 0.033 to 0.112 inch thick, attach sheathing to comply with ASTM C 954.
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film.
 - 1. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.

PART 3 - EXECUTION

3.1 INSTALLATION/ERECTION

- A. Comply with ASTM C 1280, GA-253 and manufacturer's written instructions.
 - 1. Fasten sheathing to cold-formed metal framing with screws.
 - 2. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
 - 3. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.
- B. Apply fasteners so heads bear tightly against face of sheathing boards but do not cut into facing.
- C. Horizontal Installation: Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each stud.
 - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.
- D. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.
 - 1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

END OF SECTION

SECTION 06 20 00

FINISH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Interior standing and running trim.
- B. Related Sections include the following:
 - 1. Division 6 Section "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.
 - 2. Division 9 Section "Painting" for priming and backpriming of finish carpentry.

1.3 DEFINITIONS

- A. Inspection agencies, and the abbreviations used to reference them, include the following:
 - 1. NELMA - Northeastern Lumber Manufacturers Association.
 - 2. NHLA - National Hardwood Lumber Association.
 - 3. NLGA - National Lumber Grades Authority.
 - 4. SPIB - Southern Pine Inspection Bureau.
 - 5. WWPAA - Western Wood Products Association.

1.4 SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Include construction details, material descriptions, dimensions of individual components and profiles, textures, and colors.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used, net amount of preservative retained, and chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated material.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.
 - 3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Samples for Verification:

1. For each species and cut of lumber and panel products with nonfactory-applied finish, with 1/2 of exposed surface finished, 50 sq. in. (300 sq. cm) for lumber and 8 by 10 inches (203 by 250 mm) for panels.

C. Research/Evaluation Reports: Showing that fire-retardant-treated wood complies with building code in effect for Project.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer.

B. Fire-Test-Response Characteristics: Where fire-retardant materials are indicated, provide materials with specified fire-test-response characteristics as determined by a testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency on surfaces of materials that will be concealed from view after installation.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect materials against weather and contact with damp or wet surfaces. Stack lumber, plywood, and other panels. Provide for air circulation within and around stacks and under temporary coverings.

B. Deliver interior finish carpentry only when environmental conditions meet requirements specified for installation areas. If finish carpentry must be stored in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install interior finish carpentry until building is enclosed and weatherproof, wet work in space is completed and nominally dry, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit work to be performed according to manufacturer's written instructions and warranty requirements and at least one coat of specified finish to be applied without exposure to rain, snow, or dampness.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20 and applicable grading rules of inspection agencies certified by the American Lumber Standards' Committee Board of Review.

1. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.
- B. Softwood Plywood: DOC PS 1.
- C. Hardwood Plywood: HPVA HP-1.
- D. Hardboard: AHA A135.4
- E. Medium-Density Fiberboard: ANSI A208.2, Grade MD-Exterior Glue.

2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated lumber and plywood are indicated, use materials impregnated with fire-retardant chemicals by a pressure process or other means acceptable to authorities having jurisdiction to produce products with the following fire-test-response characteristics:
 1. Flame-spread index of not greater than 25 when tested according to ASTM E 84
- B. For exposed items indicated to receive transparent finish, do not use chemical formulations that contain colorants or that bleed through or otherwise adversely affect finishes.
- C. Interior, Low-Hygroscopic-Type, Fire-Retardant Treatment: Formulation that results in treated material with an apparent moisture content of not more than 28 percent when tested according to ASTM D 3201 at 92 percent relative humidity.
- D. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber and plywood from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
- E. Kiln-dry material after treatment to levels required for untreated material. Do not use material that does not comply with requirements for untreated material or is warped or discolored.

2.3 INTERIOR STANDING AND RUNNING TRIM

- A. Softwood Lumber Trim for Transparent Finish (Stain or Clear Finish): Kiln-dried finished lumber (S4S) of one of the following species and grades:
 1. Select eastern white pine; Idaho white, poplar, or sugar pine NELMA, NLGA.or WWPA.
- B. Hardwood Lumber Trim for Transparent Finish (Stain or Clear Finish): Clear Grade A finish, kiln-dried, white maple unless otherwise indicated.
- C. Lumber Trim for Opaque Finish (Painted): Finished lumber (S4S), either finger-jointed or solid lumber, of one of the following species and grades:
 1. Grade: Finish or 1 Common. Poplar or Birch, NELMA WWPA.or NLGA.

2.4 PANELING

- A. Hardwood Veneer Plywood Paneling: Manufacturer's stock hardwood plywood panels complying with applicable requirements in HPVA HP-1.
- B. Board Paneling: Interior wood board paneling complying with WMMPA WM 9.

2.5 MISCELLANEOUS MATERIALS

- A. Fasteners for Interior Finish Carpentry: Nails, screws, and other anchoring devices of type, size, material, and finish required for application indicated to provide secure attachment, concealed where possible.
 - 1. Where finish carpentry materials are exposed in areas of high humidity, provide fasteners and anchorages with hot-dip galvanized coating complying with ASTM A 153/A 153M.

2.6 FABRICATION

- A. Wood Moisture Content: Comply with requirements of specified inspection agencies and with manufacturer's written recommendations for moisture content of finish carpentry at relative humidity conditions existing during time of fabrication and in installation areas.
- B. Back out or kerf backs of the following members, except members with ends exposed in finished work:
 - 1. Interior standing and running trim, except shoe and crown molds.
 - 2. Wood board paneling.
- C. Ease edges of lumber less than 1 inch (25 mm) in nominal thickness to 1/16-inch (1.5-mm) radius and edges of lumber 1 inch (25 mm) or more in nominal thickness to 1/8-inch (3-mm) radius.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Before installing finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours[, unless longer conditioning is recommended by manufacturer].

3.3 INSTALLATION, GENERAL

- A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.
 - 1. Do not use manufactured units with defective surfaces, sizes, or patterns.
- B. Install finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
 - 1. Scribe and cut finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
 - 2. Countersink fasteners, fill surface flush, and sand where face fastening is unavoidable.
 - 3. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.
 - 4. Coordinate finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate finish carpentry.

3.4 STANDING AND RUNNING TRIM INSTALLATION

- A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long, except where necessary. Stagger joints in adjacent and related standing and running trim. Cope at returns and miter at corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.
 - 1. Match color and grain pattern across joints.
 - 2. Install trim after gypsum board joint finishing operations are completed.
 - 3. Drill pilot holes in hardwood before fastening to prevent splitting. Fasten to prevent movement or warping. Countersink fastener heads on exposed carpentry work and fill holes.

3.5 ADJUSTING

- A. Replace finish carpentry that is damaged or does not comply with requirements. Finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.6 CLEANING

- A. Clean finish carpentry on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

END OF SECTION 06 20 00

SECTION 06 40 23

ARCHITECTURAL WOODWORK

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this section.

1.2 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to, interior architectural woodwork including the following:
 - 1. Plastic laminate casework and countertops.
 - 2. Solid surface countertops.
 - 3. Display cases.

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to:
 - 1. Section 01 43 39, Mock-Ups; Requirements for mock-ups.
 - 2. Section 05 50 00, Metal Fabrications; counter supports.
 - 3. Section 06 10 00, Rough Carpentry; blocking, grounds and nailers.
 - 4. Section 12 32 13, Manufactured Casework
 - 5. Division 22 - Plumbing; coordination with plumbing requirements.
 - 6. Division 26 - Electrical; coordination with electrical requirements.

1.4 SUBMITTALS

- A. Certifications: Provide certifications stating that materials and fabrication complies with specification requirements.
- B. Shop Drawings: Provide large scale shop drawings for fabrication, installation and erection of all parts of the work. Provide large scale detailed plans, elevations, and details of anchorages, connections and accessory items.
- C. Field Measurements: Take accurate field measurements before preparation of shop drawings and fabrication. Do not delay job progress; allow for field cutting and fitting where taking field measurements before fabrication is not possible.
- D. Verification Samples: Submit at least two fully finished representative samples minimum 12

by 12 inches in size of each material that is to be exposed in the finished work, showing the full range of color and finish variations expected.

1.5 QUALITY ASSURANCE

- A. Source: For each material type required for work of this Section, provide primary materials which are product of one manufacturer. Provide secondary or accessory materials which are acceptable to manufacturers of primary materials.
- B. Installer: A firm with a minimum of three years experience in type of work required by this Section.
- C. Quality Standard: Provide work complying with applicable requirements of AWI Quality Standards. Where not otherwise indicated, fabricator may choose among options permitted by AWI for grade of work specified.
 - 1. Panel Products: Provide minimum 45 pounds per cubic foot medium density particleboard. Do not use hardboard.
- D. Mock-Ups: Prior to commencing the primary work of this Section, provide mock-up of architectural woodwork items at locations acceptable to Architect. Obtain Architect's acceptance of visual qualities. Protect and maintain accepted mock-ups throughout the remainder of the work of this Section to serve as criteria for acceptance of the work. Approved mock-ups may be incorporated in the finish work. Provide the following:
 - 1. Section of countertop.
 - 2. Typical section of casework.
 - 3. Wood base.

1.6 PROJECT CONDITIONS

- A. Substrates: Proceed with work only when substrate construction and penetration work is complete.
- B. Wet Work: Proceed with work of this Section after wet work has been complete and fully dry or cured. Wet work is defined as plaster, gypsum drywall, paint, concrete, etc.
- C. Conditioning: Advise Contractor of temperature and humidity requirements for woodwork installation. Do not install work of this Section until required temperature and relative humidity in areas of installation has been stabilized and will be maintained.

PART 2 - PRODUCTS

2.1 VENEERS AND LUMBER

- A. Quality Standard: Provide AWI Premium Grade materials and workmanship.

- B. Veneers and Lumber: Provide AWI Lumber Grade 1 and AWI Grade A Veneer, book-matched, minimum 6" face veneer width. Match adjacent pieces for color and grain pattern.
 - 1. Species: Unless otherwise indicated on Drawings, Hard Maple (*Acer saccharum*) "Select White" (sapwood), Plain-sliced, Grade FAS (1) or better

2.2 PLASTIC LAMINATE

- A. Plastic Laminate Manufacturers: Provide plastic laminate materials that meet or exceed specified requirements from one of the following manufacturers, or Architect approved equals:
 - 1. Formica Decorative Laminates; Formica Corporation, Cincinnati, OH 45241.
 - 2. Nevamar Decorative Laminates; Nevamar Corporation; Odenton, MD 21113.
 - 3. Wilsonart Decorative Laminates., Ralph Wilson Plastics Co.; Temple, TX 76501.
- B. Provide laminate complying with NEMA LD 3, and the following:
 - 1. Horizontal and Vertical Surfaces (Except Postformed Surfaces): General Purpose Standard Grade, GP-50 (0.50 in. nominal thickness).
 - 2. Postformed Surfaces: Postforming Type, PF-42 (0.42 in. nominal thickness).
 - 3. Balance Sheet: Backer Type, BK-20 (0.20 in. nominal thickness).
 - 4. Color/Texture/Pattern: selected by Architect.
- C. Core: Provide medium density, phenolic resin, particleboard (Type 1-M-1) core for all plastic laminate work. Provide minimum 45 pcf medium density particleboard. Do not use hardboard.

2.4 CASEWORK

- A. Quality Standard: Provide AWI Premium Grade materials and workmanship.
- B. Wood Species and Cuts: Hard Maple (*Acer saccharum*) "Select White" (sapwood), Plain-sliced, Grade FAS (1) or better.
- C. Plastic Laminate: Provide as specified above:
 - 1. Color/Texture/Pattern: as selected by Architect.
 - 2. Construction: Provide balancing sheets for work. Fabricate work for use in wet environments. All surfaces of core shall be covered with laminate. Provide loose splashes with six sides covered with laminate. All exposed surfaces shall be covered with "face" laminate.
- D. Door Frames: Reveal overlay, to profiles indicated on the Drawings. Coordinate with hardware requirements.
- E. Dust Panels: Provide plywood dust panels in work.
- F. Preparation for Related Work: Prepare for electrical, telephone, mechanical, and plumbing work. Cut holes to fit templates of appliances and fixtures. Trim openings so that core

materials are covered with laminate.

G. Hardware:

1. Hinges: Stanley 1560 series, self-closing.
2. Drawer and Door Pulls: Hafele Model No. 102.42.618.
3. Drawer Slides: Accuride C3800.
4. Adjustable Shelf Hardware: Recessed Knap and Vogt 233 with 237 shelf clips.
5. Touch Latches: Hafele Model No. 244.01.
6. Door Silencers: Glynn Johnson GJ-65.
7. Locks: Timberline Model No. CB-291 with No. SP-185 strike plate.
8. Grommets: 2" diameter grommets at countertops
9. Countertop Support Brackets: Extra heavy duty RAKKS EH-1818.

H. Drawer Construction: multiple dovetail construction with applied drawer fronts.

I. Casework Joinery: Fabricate countertops to have fewest possible seams. Locate seams where shown on shop Drawings as approved by Architect. Do not use any exposed fasteners or connectors. Use concealed bolts to hold seams and joints hairline, lightproof tight.

2.5 SOLID SURFACE COUNTERTOPS

A. Solid Surfacing Manufacturer: Provide solid surfacing materials that meet or exceed specified requirements from the following manufacturer, or Architect approved equals:

1. "Corian", by DuPont
2. "Swanstone" by Swan Corp.
3. "Glacial Quartz" by InPro Corp.

B. Solid Surfacing Material: Homogeneous solid sheets of filled plastic acrylic resin complying with the material and performance requirements of ANSI Z124.3, Type 6, and Fed. Spec. WW-P-541E/GEN, without a precoated finish.

2.6 DISPLAY CASEWORK

A. Quality Standard: Provide AWI Premium Grade materials and workmanship.

B. Wood Species and Cuts: Hard Maple (*Acer saccharum*) "Select White" (sapwood), Plain-sliced, Grade FAS (1) or better.

C. Tack panel material:

1. Core Surfaces: One-piece unit shall be 1/2" thick high-density mineral fiberboard meeting Class II fire retardant requirements. Height and width as required per the drawings.
2. The face, all edges, and a return on the back of a minimum of 1 1/2" shall be covered with a minimum 20 oz. Type II vinyl as manufactured by Koroseal, Desert Sand Series, or approved equal.
3. Mount all panels utilizing panel adhesive system or concealed fasteners.

- D. Glass Shelves and Doors: Provide clear tempered glass as specified in Section 08 81 00.
- E. Provide sliding glass door hardware and locks.

2.7 SHOP FINISHING

- A. Interior Architectural Woodwork and Doors for Satin Transparent Finish Where Indicated (all hardwoods and hardwood veneers): AWI Premium Grade TR-5, catalyzed vinyl, with stain and UV protective coating.

2.9 INSTALLATION MATERIALS

- A. Blocking, Shims, and Nailers: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
- B. Screws: Select material, type, size, and finish required for each use, nonferrous metal or hot-dip galvanized, unless otherwise indicated. Comply with ASME B18.6.1 for applicable requirements.
- C. Nails: Stainless-steel nails, type, size, and finish required for each use. Comply with FS FF-N-105..
- D. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous metal or hot-dip galvanized anchors and inserts, unless otherwise indicated. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors.

PART 3 - EXECUTION

3.1 WORKMANSHIP - GENERAL

- A. Work of this Section shall conform to design and detail indicated. Where practicable, work shall be finished and assembled at architectural millwork shop.
- B. Work shall be finished smooth and free from machine or tool marks that will telescope through finish.

3.2 INSTALLATION

- A. Preinstallation Meeting: Convene conference to establish procedures to maintain optimum working conditions and coordinate with related work. Require woodwork manufacturer, Installer, Contractor, and Architect to attend.
- B. The Installer shall examine substrates, supports, and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected.

- C. Condition woodwork to average prevailing humidity conditions in installation areas prior to installation.
 - D. Proceed with installation only when required ambient conditions have been properly maintained, as determined by all attending pre-installation conference.
 - 1. Provide work to sizes, shapes, and profiles indicated on approved shop drawings.
 - 2. Install work to comply with quality standards and tolerances specified for shop work.
 - 3. Color match wood at joints and seams to minimize expression of joints and seams in transparent finished work.
 - E. Install architectural woodwork plumb, level, true and straight. Shim as required using concealed shims. Install work, including tops, to a tolerance of $\pm 1/8$ in. in 8 ft.
 - F. Scribe and cut architectural woodwork to fit adjoining work. Refinish cut surfaces.
 - G. Anchor casework securely in place.
- 3.3 REPAIRING AND PROTECTION
- A. Repair minor damage to eliminate all evidence of repair. Remove and replace work which cannot be satisfactorily repaired.
 - B. Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protections and reclean as necessary immediately before final acceptance.

END OF SECTION 06 40 23

SECTION 07 11 13

BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this section.

1.2 DESCRIPTION OF WORK

- A. The work of this Section includes, but is not limited to:
 - 1. Cold-applied asphalt emulsion dampproofing at foundation walls.

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to:
 - 1. Section 03 30 00, Cast-In-Place Concrete.
 - 2. Section 07 21 00, Insulation.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications and installation instructions for products in bituminous dampproofing system, including certifications and other data as may be required to show compliance with Contract Documents.
- B. Substrate Acceptability: Submit a certified statement issued by manufacturer of dampproofing materials and countersigned by applicator, attesting that areas and surfaces designated to receive dampproofing have been inspected and found satisfactory for reception of Work covered under this Section; and are not in conflict with "Warranty" requirements. Application of materials will be construed as acceptance of surfaces.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Obtain primary dampproofing materials of each type required from a single manufacturer to the greatest extent possible. Provide secondary materials only as recommended by manufacturer of primary materials.
- B. Installer: A firm which has at least three years experience in work of the type required by this section and which is acceptable to the manufacturer of the primary materials.

- C. Subdivision of Work: To limit responsibility, assign all work related to dampproofing including, but not limited to, joint fillers and sealers, surface preparation, and the like to the dampproofing installer.
- D. Manufacturer's Representation: Make all arrangements and payments necessary to have manufacturer's authorized representative on-site at beginning of waterproofing work to advise installer and to ensure compliance with manufacturer's requirements.

1.6 PROJECT CONDITIONS

- A. Conditions: Perform work only when ambient conditions are within the limits established by manufacturers of the materials and products used.
- B. Substrate: Proceed with work after substrate construction, openings, and penetrating work have been completed and areas are free of standing or running water, ice, and frost. Verify that concrete is dry, smooth, and free from sharp or ragged out-angles, honeycombing, rock pockets, depressions, and projections.
- C. Coordinate application of dampproofing with work of other trades.
- D. Ventilation: Comply with manufacturer's requirements and recommendations throughout application and curing.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's unopened containers or bundles fully identified with brand, type, grade, date of manufacture, class, lot number, and other qualifying information.
- B. Store materials in original tightly sealed containers or unopened packages. Materials shall be stored out of weather, off the ground, in dry area, in compliance with manufacturer's maximum storage temperature range.
- C. Sequence deliveries to avoid delays, but minimize on-site storage.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Provide products of one of the following manufacturers if they meet or exceed the requirements of these specifications:
 - 1. J & P Petroleum Products, Inc.
 - 2. Karnak Chemicals
 - 3. Pecora Corporation
 - 4. Sonneborne Building Products

2.2 PRODUCTS

- A. Asphalt Emulsion Dampproofing: Provide non-fibrated type liquid emulsion conforming to ASTM D1187, type B or ASTM D1227, Type II.

PART 3 - EXECUTION

3.1 INSPECTION

- A. The Installer shall examine substrates, supports and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Do not dampproof over frozen substrates. Beginning work means Installer accepts substrates and conditions.

3.2 INSTALLATION

- A. Strictly comply with manufacturers' instructions and recommendations, except where more restrictive requirements are specified in this section.
- B. Clean substrate, fill voids, seal joints, and prime substrate all as recommended by manufacturer.
- C. Install separate flashings, corner protection strips and cants as recommended by manufacturer even if not shown on drawings.
- D. Protect adjacent work from spillage and migration. Do not clog pipes and conduits.
- E. At foundations, spray or brush two coats with minimum 1/16" thick total dry film thickness of dampproofing from 2" below finished grade to top of footing and across top of footing. Provide 100% coverage on surfaces indicated and on surfaces which are subject to water damage.

3.3 PROTECTION

- A. Where backfilling is indicated, provide insulation board and protection board over completed and cured dampproofing. Fit tightly around obstructions and penetrations. Adhere protection board with additional dampproofing material.

END OF SECTION

SECTION 07 21 00

THERMAL INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. The work of this Section includes, but is not limited to:
 - 1. Batt insulation at stud cavity.
 - 2. Rigid mineral wool insulation at masonry cavity and rainscreen panels.
 - 3. Extruded polystyrene insulation at foundation walls and floor slabs.
 - 4. Spray foam insulation.
 - 5. Vapor Barrier underslab.
- B. Related work specified elsewhere:
 - 1. Section 07 53 23, EPDM Roofing: Rigid insulation at roof system.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations for each material used. Provide certifications stating that materials comply with requirements and are intended for use indicated.
- B. Test Reports: Submit certified test reports for performance required.

1.4 QUALITY ASSURANCE

- A. Fire Performance: Provide products which meet or exceed flammability ratings indicated and required by authorities having jurisdiction.
 - 1. Except as otherwise indicated, provide insulation with flame spread rating of 25 or less, when tested in accordance with ASTM E 84-08.
- B. Thicknesses: Where thicknesses are indicated, they are related to the k-values specified. Provide additional thickness, if necessary, to obtain the same level of performance with acceptable substitute materials which have different values of thermal conductivity. Where R-values are indicated, provide thickness required to achieve value specified.

- C. Assembly performance: Insulation shall provide thermal resistance to provide the assembly U-values required by the energy code analysis.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from moisture and damage. Protect plastic insulations from sunlight. Take every possible precaution to avoid fire; conceal materials within building assemblies as quickly as possible. Sequence deliveries to avoid delays, but minimize on-site storage.

PART 2 - PRODUCTS

2.1 BATT INSULATION

- A. Resilient, flexible batts of inorganic, non-asbestos mineral fibers, ASTM C518:
 - 1. Manufacturer/Product: Thermafiber Ultrabatt or Rockwool Comfort Batt
 - 2. R-Value per inch: nominal 4.0.
 - 3. Type: Unfaced
 - 4. Surface-Burning Characteristics: ASTM E 84. flame spread 0 smoke-developed 0.
 - 5. ASTM E 136: Non-combustible

2.2 RIGID POLYISOCYANURATE INSULATION

- A. Mineral Wool Board Continuous Wall Insulation: ASTM C 612, with flame spread index 0 per ASTM E 84.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Rockwool CavityRock or comparable product by one of the following:
 - a. Owens Corning Thermafiber.
 - b. JohnsManville CladStone.
 - 2. Thickness: As indicated on Drawings.
 - 3. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285..

2.3 RIGID EXTRUDED POLYSTYRENE INSULATION

- A. Extruded Polystyrene Board, Type VI: ASTM C 578, Type VI, 40-psi minimum compressive strength; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84. Subject to compliance with requirements, provide products by one of the following:
 - 1. DiversiFoam Products.
 - 2. Dow Chemical Company (The).
 - 3. Owens Corning.

2.4 SPRAY FOAM INSULATION

- A. Two-component, quick-cure spray applied polyurethane foam: FROTH-PAK Foam Insulation by Dow Building Products or equivalent. UL listed, Class-A rating (flame spread of 25 or less).

Nominal density 1.75 psf, Compressive strength nominal 17 psi. Vapor permeance 3.2 perms at 2" thickness. R value nominal 6.0 per inch aged.

2.5 VAPOR BARRIER

- A. Vapor barrier beneath concrete slabs: Polyethylene Vapor Retarders, EVOH type: ASTM D 4397, 20 mil thick sheet, with maximum permeance rating of 0.1 perm.
 - 1. Puncture Resistance ASTM D 1709 Method B, 3500g Impact energy required to cause failure
 - 2. Tensile Strength ASTM D 882, 100 lbf/in Force required to break/rupture film
 - 3. Permeance After Conditioning ASTM E 154, Resistance to water vapor after:
 - Section 11 0.1 perms 0.0066 perms -heat conditioning
 - Section 12 0.1 perms 0.0068 perms -low-temperature conditioning
 - Section 13 0.1 perms 0.0073 perms -soil organism exposure
 - 4. Methane Transmission Rate ASTM D 1434, ,100 mL (STP)/(m² • day) Transmission through membrane
 - 5. Radon Permeability Coefficient: 8.3 x 10⁻¹⁴ m²/sec

PART 3 - EXECUTION

3.1 INSPECTION

- A. The Installer shall examine substrates, supports, and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means Installer accepts substrates and conditions.

3.2 INSTALLATION

- A. General Installation Requirements: Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section.
 - 1. Clean substrates and remove projections which could puncture vapor barriers.
 - 2. Extend insulation over entire area indicated to be insulated.
 - 3. Fit tightly around penetrations and obstructions. Fill all holes, gaps and voids including voids and shim spaces at door and window perimeters.
 - 4. Do not over compress insulation.
 - 5. Provide insulation in one layer with tightly butted edges, unless indicated otherwise.
 - 6. Provide continuous installation of vapor barrier with joints and transitions lapped and or sealed and punctures repaired.
- B. Wall Insulation: Coordinate with masonry and cement panel systems. Adhere board-type insulations to clean substrate with spot application of adhesive compatible with adjacent materials and approved by the insulation manufacturer. Extend insulation over the area shown. Foundation insulation shall be continuous to below the frost depth or as indicated.
- C. Vapor Barriers: Install polyethylene vapor barriers with taped joints, repaired tears and holes, and seal to adjacent vapor barrier material.

3.3 PROTECTION

- A. Provide temporary protection to ensure work being without damage or deterioration from weather or physical abuse.

END OF SECTION

SECTION 07 27 16

SHEET MEMBRANE AIR BARRIERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. UV and fire-resistant, self adhered sheet membrane designed to provide a permeable air and water barrier when applied to above-grade wall assemblies.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for each material. Include standard details, certified test results, installation instructions, and recommendations for sealing penetrations and perimeter.
- B. Samples: Submit three labeled samples of each product, not less than 6 by 12 inches in size.
- C. Shop Drawings for Air and Vapor Barriers: Submit shop drawings indicating details of construction for continuous air and vapor barrier required by code for each type of exterior wall and roof assembly required for the project. Include relationship with adjacent materials, indication of sequence of installation, and materials and methods for sealing connections and penetrations. At a minimum, shop drawings shall include details of the following connections, as applicable to the project:
 - 1. Walls and windows or doors.
 - 2. Different wall systems.
 - 3. Wall and roof.
 - 4. Wall and roof over unconditioned space.
 - 5. Walls, floor and roof across construction, control and expansion joints.
 - 6. Walls, floors and roof to utility, pipe and duct penetrations.
- D. Dew Point Analysis: Prior to purchase of building materials for exterior wall and roof assemblies, submit dew point analysis for each exterior wall assembly required for the project, including materials and interior and exterior air films. If analysis does not indicate 0.0 ounces of accumulation at conditions specified below, include list of recommendations and materials which will produce 0.0 ounces of accumulation. At a minimum, dew point analysis shall include the following:
 - 1. R-values of materials actually proposed for use, specific to manufacturer selected.
 - 2. Graph of temperature versus distance from interior.
 - 3. Temperature conditions of 72 degrees F interior and 0 degrees F exterior.

4. Humidity conditions of 35 percent interior and 60 percent exterior
 5. Potential accumulation of water in ounces per day per square foot.
- E. Qualifications of Installer: Submit qualifications of firm installing air and vapor barrier membrane materials, including name and qualifications of supervisor for this project, and including name and location of three projects where similar work was performed by both firm and supervisor.

1.4 PERFORMANCE REQUIREMENTS

- A. Air Barriers: The building envelope shall be designed and constructed with a continuous air barrier to control air leakage into, or out of the conditioned space. An air barrier shall also be provided for interior partitions between conditioned space and space designed to maintain temperature or humidity levels which differ from those in the conditioned space by more than 50 percent of the difference between the conditioned space and design ambient conditions. The air barrier shall have the following characteristics:
1. It must be continuous, with all joints made air-tight.
 2. It shall have an air permeability not to exceed 0.04 cubic feet per minute per square foot under a pressure differential of 0.3 in. water.
 3. It shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load.
 4. It shall be durable or maintainable.
 5. The air barrier shall be joined in an air-tight and flexible manner to the air barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between:
 - a. Foundation and walls.
 - b. Walls and windows or doors.
 - c. Different wall systems.
 - d. Wall and roof.
 - e. Wall and roof over unconditioned space.
 - f. Walls, floor and roof across construction, control and expansion joints.
 - g. Walls, floors and roof to utility, pipe and duct penetrations.
- B. Air Barrier Penetrations: All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made air-tight.
- C. Design Intent: Air barrier membrane shall be located, constructed and flashed to perform as an air and air and vapor barrier to discharge to the outside any incidental condensation or water penetration. Air barrier membrane shall accommodate movements of building materials by providing expansion and control joints as required, with appropriate air seal materials at such locations, changes in substrate and perimeter conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS/PRODUCTS

- A. Above Grade Air and Water Barrier: Basis of Design Henry Blueskin self-adhered water resistive vapor permeable air barrier membrane comprised of rubberized asphalt and dual-layers of high strength polyethylene.
 - 1. Permanent UV exposure under open joint cladding.
 - 2. Compatible with other air barrier system components
 - 3. Compliant with NFPA 285 in wall assembly provided on this project.
 - 4. Low temperature application down to 20 °F (-7 °C)
 - 5. Living Building Challenge Declare label (Red List Free)
 - 6. 100% solids - No VOC's
 - 7. Vertical and lateral flame propagation: meets NFPA 285 per ASTM E1354 and ASTM E84
 - 8. Thickness - 40 mils,
 - 9. Self-adhering vapor permeable air barrier membrane for transition and joint treatment detailing shall be Blueskin VP 160 manufactured by Henry, a self-adhering membrane consisting of engineered film and a patented, permeable adhesive with a split-back poly-release film.
 - 10. Liquid-applied flashing for window, door, MEP penetrations, inside/outside and dissimilar material connections shall be Air-Bloc LF manufactured by Henry; a moisture-curing single component STPe liquid-applied flashing compatible with a variety of substrates and all Henry liquid and self-adhered air barrier membranes.
 - 11. Through-wall flashing membrane (Self-Adhering) shall be Blueskin TWF manufactured by Henry; an SBS modified bitumen, self-adhering sheet membrane complete with a yellow engineered thermoplastic film.

PART 3 EXECUTION

3.1 GENERAL PREPARATION

- A. Proceed with air and vapor barrier membrane installation only after substrate preparation is complete. Obtain approval from the membrane manufacturer's representative of gypsum sheathing surface preparation before proceeding with membrane installation.
- B. Clean the existing surface prior to installing air and vapor barrier membrane components to remove all dirt and debris. Do not install air and vapor barrier system components over wet substrates.

3.2 GENERAL WORKMANSHIP

- A. Coordinate flashing and sealant work to ensure a concurrent membrane and flashing installation.
- B. The completed air and vapor barrier membrane and flashing system shall be protected from damage. All damage to finished portions or the air and vapor barrier membrane shall be

either repaired or replaced in a manner acceptable to the Owner, and the cost of such corrective work shall be paid by the trade responsible for damage.

3.3 INSTALLATION

- A. Strictly comply with air and vapor barrier membrane manufacturer's printed instructions, approved submittals and the following:
 - 1. Apply materials within manufacturer's requirements for temperature and weather conditions.
 - 2. Do not apply to wet or frozen substrates.
 - 3. Do not allow contamination with dust or dirt.
 - 4. Seal completely at edges, perimeter and penetrations.
 - 5. Apply primer if recommended by manufacturer.
- B. Protect installed work from damage due to harmful weather exposures, physical abuse, and other causes.

3.4 FLASHINGS

- A. All flashings shall be installed concurrently with the air and vapor barrier membrane as the job progresses. No temporary flashing shall be allowed without the prior written approval of the Architect and membrane manufacturer. Approval shall be for specific locations on specific dates. Flashings shall be adhered to compatible, dry, smooth, and solvent-resistant surfaces.

3.5 CLEAN-UP

- A. Upon completion of the system, clean all stains, remove all masking, protections, equipment, material, and debris from the work and storage area, and leave those areas in an undamaged and acceptable condition.

END OF SECTION

SECTION 07 46 46

RAIN SCREEN CLADDING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Furnish and install rain screen wall system including fiber cement wall panels, suspension system, insulation, related flashings, weather barrier and accessory components.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide manufactured wall panel assemblies complying with performance requirements indicated and capable of withstanding structural movement, thermally induced movement, and exposure to weather without failure or infiltration of water into the building interior.
- B. Design, fabricate, and erect a drained and back ventilated "rainscreen" wall panel system to meet the following requirements.
 - 1. Rain penetration: prevent rain penetration through wall system. Design system based on drained and back ventilated "Rain Screen Principal." Incorporate means of draining to the exterior.
- C. Structural Performance: Design wall system to resist wind loads, positive and negative, expected in this geographical region without causing rattling, vibration, or excessive deflection of panels, overstressing of fasteners, clips and other detrimental effect.
 - 1. Maximum Deflection: 1/360 of the span.
- D. Wind Load as determined by ASCE-7 and complying with Building Code.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Minimum 5 years' experience specializing in the manufacturing of façade attachment/support framing similar to those specified.
 - 2. Ability to demonstrate conformance to testing requirements.
- B. Installer Qualifications: Minimum of 3 years' documented experience and 5 completed projects of equivalent scope and quality and recommended by manufacturer to perform work

of this Section. Installer shall be approved by system manufacturer and have completed manufacturer's installation training. Certification is required to be submitted with bid Qualification forms.

- C. Engineer Qualifications: Registered professional engineer experienced in the design of curtain wall systems, anchors, fasteners and licensed in the State of New York.
- D. Pre-Installation Meeting:
 - 1. Discuss sequence and scheduling of work and interface with other trades.
 - 2. Review assemblies for potential interference and conflicts and coordinate layout and support provisions for interfacing work.
 - 3. Review and document methods, procedures and manufacturer's installation guidelines and safety procedures for exterior wall assembly.

1.5 SUBMITTALS

- A. Product Data: Include manufacturer's product specifications, standard details, certified product test results, and general recommendations, as applicable to materials and finishes for each component and for total panel assemblies.
- B. Shop Drawings: Show layouts of panels, details of corner conditions, joints, panel profiles, supports, anchorages, trim, flashings, closures, and special details. Distinguish between factory- and field-assembled work.
 - 1. For installed products indicated to comply with certain design loadings, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Samples for Verification: For each type of panel, provide sample panels 12 inches long by actual panel width, in the profile, style, color, and texture indicated. Include clips, caps, battens, fasteners, closures, and other exposed panel accessories.
- D. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- E. Product Test Reports: Indicate compliance of manufactured wall panel assemblies and materials with performance and other requirements based on comprehensive testing of current products.
- F. Structural Calculations:
 - 1. Submit rainscreen attachment manufacturer's comprehensive Structural Design analysis signed and sealed by a Professional Engineer.

1.6 MOCK UP

- A. Provide mock-up of corner assembly, minimum 4' x 4' x 4', demonstrating sill, head, jamb and corner conditions. Include all elements of the system: back-up framing, gypsum sheathing, air/weather barrier, insulation, flashing, panel attachment system, panels, closures, sealants

and accessories. Obtain Architect's approval of mock-up prior to beginning construction of the wall system.

1.7 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. System Performance Warranty: Manufacturer and Installer agree to repair or replace components of the composite wall panel assembly (rain screen panel system) that do not comply with performance requirements or that fail in materials or workmanship within specified warranty period. This includes all labor and materials required to eliminate failures and return the envelope to a complete performing system.
 - 1. Failures include, but are not limited to, the following:
 - a. Water penetration through the envelope system.
 - b. Structural failures including, but not limited to, excessive deflection.
 - c. Noise or vibration created by wind and thermal and structural movements.
 - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - e. Failure of operating components.
 - 2. Warranty Period: 10 years from date of Substantial Completion.
- C. Special Finish Warranty: Submit a written warranty, signed by manufacturer, covering failure of the factory-applied exterior finish on metal wall panels within the specified warranty period and agreeing to repair finish or replace wall panels that show evidence of finish deterioration. Deterioration of finish includes, but is not limited to, color fade, chalking, cracking, peeling, and loss of film integrity.
 - 1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 COMPOSITE PANELS

- A. Basis of Design: Equitone Materia fiber cement panels with Knight Wall panel rail support system.
- B. Fiber Cement Panels: Through body color and material high-density fiber cement panels complying with ASTM C 1186/EN 12467, Type A Grade IV and performance requirements indicated below:
 - 1. Format Panel Sizes: 9/16" thick.
 - a. Panel sizes as indicated on drawings.
 - b. Tolerances:
 - 1) Length: +/- 1/16" (2mm)
 - 2) Width: +/- 1/16" (2mm)
 - 3) Thickness Within a Sheet: <10%
 - 4) Thickness Sheet to Sheet: < +/-0.05"

2. Modulus of Elasticity (Wet): 1,740,452 psf
 3. Flexural Strength (Equilibrium): 3190 psi
 4. Panel Density: 100 lb/ft³
 5. Curing Method: Air cure
 6. Water Absorption: ≤2%
 8. Surface Burning Characteristics: ASTM E84 (EN-13501)
 - a. Flame Spread Index: 0 (A2)
 - b. Smoke Development Index: 0 (s1)
 9. Combustibility (ASTM E136): Non-combustible
 10. Color:
 - a. As selected by the architect from the manufacturer's full line of colors and finishes
 - b. Color as indicated on drawings
 11. Surface:
 - a. lightly sanded surface
 - b. medium sanded surface
 12. Surface treatment: Manufacturer's standard factory applied hydrophobic coating
- B. Panel Attachment:
1. Stainless steel exposed fastener system.
 - a. Coordinate attachment system with sub-girt system and expansion/thermal movement requirements of panels.
 - b. Use corrosion resistant fasteners and anchors of type, size, and spacing required for type of substrate and project conditions to meet performance requirements specified and indicated in design calculations.
- C. Support Framing System:
1. Comply with ANSI/ASHRAE 90.1-2010.
 2. Coating Material: ASTM A1046, Zinc-Aluminum-Magnesium, minimum thickness ZM40.
 3. Steel Classification: Structural Steel (SS), Grade 50, 50 ksi Yield.
 4. Spacing: Comply with manufacturer's Professional Engineer's project specific calculations.
 5. Wall Brackets: ThermaBracket-D by Knight Wall Systems or approved equal.
 - a. Minimum 0.074 inch thick (14 gauge) sheet steel.
 - b. Bracket Base: Minimum 3.125 inch high by 2.125 inch wide.
 - c. Offset Brackets: depth as shown on Drawings.
 - d. Pre-Punched Holes: Minimum two wall anchors per bracket.
 - e. Rail Connector Stem:
 - 1) Pilot Drill Holes:
 - 2) Holes allow minimum 0.75 inch adjustment allowing for aligning and plumbing of framing, independent of substrate irregularities and proper cladding installation.
 - 3) Spaced appropriately to maintain proper alignment of rails.
 6. Primary Rail, Dynamic D Series:
 - a. Minimum 0.046-inch thick (18 gauge) [0.054-inch thick (16 gauge)] cold-formed steel.
 - b. Profile: C channel, two flanges of equal length and one web.
 - c. Nominal Dimensions: 1.625 inch flange for attaching to wall bracket and 1.625 inch at web.
 - d. Adjustment capability: 0.75-inches.

- e. Pre-Punched Attachment Holes: 1.0 inch on center along length of track and oversized allowing for thermal contraction and expansion of rail without placing stress on connection.
- 7. Secondary Rail: Nominal 0.054-inch thick (16 gauge) cold-formed steel.
 - a. Profile: Hat channel with stiffening lips.
 - b. Profile Depth: 0.75 inches.
 - c. Girt Fastening Face: Manufacturer's recommendation as Engineered.
 - d. Weep Drains: 0.75 inches diameter at 4 inches on center along flanges to allow for free air flow laterally.
 - e. Attachment Holes: Locate at 2 inch on center along back to facilitate number 14 self-drilling self-tapping screw attachment to primary rail. Oversize holes to allow for thermal contraction and expansion of rail.
- 8. Reveal Rail: Nominal 0.054-inch thick (16 gauge)] cold-formed steel.
 - a. Profile: Square hat channel with stiffening lips.
 - b. Depth: 0.75 inches.
 - c. Dimensions: 2.0 inches at web, 1.625 inches at each flange with 0.25 stiffening lips.
- 9. Thermal Isolation:
 - a. Material: Injection molded Polyoxymethylene copolymer (POM), non-fiber reinforced.
 - b. Tensile Yield Strength: 9.57 ksi per ISO 527.
 - c. Melting Temperature: 329 degrees Fahrenheit per ISO 3146.
 - d. Components:
 - 1) Wall Anchor Isolation Washer: minimum 0.125 inch thick.
 - 2) Support Wall Substrate Isolation: Minimum 0.375-inch thick at each wall bracket.
 - 3) Rail to Bracket Isolation: Minimum 0.125 inch thick at each connection.
 - 4) Bracket Shim: Match support wall substrate isolator profile; available in 0.125-inch thickness and does not decrease thermal or structural performance of system.
- 10. Fasteners:
 - a. Sufficient length to provide solid attachment to structure as required by manufacturer.
 - b. Thermally isolated.
 - c. Framed substrate with sheathing: Self-drill hex-washer-head stainless steel with 1,000 hour salt-spray rated thermoset polyester coating. Embedment depth: 0.625 inches or three full threads minimum, whichever is greater. Minimum ultimate pull-out capacity from 18 gauge steel: 450 pounds.
 - d. Concrete and concrete masonry units substrate: Embedment depth: 1.25 inches minimum. Minimum ultimate pull-out capacity from substrate material: 450 pounds.
- 11. For primary to secondary rail connection: Self-drill hex-washer-head stainless steel with 1,000 hour salt-spray rated thermoset polyester coating. Embedment depth: 0.625 inches or three full threads minimum, whichever is greater. Minimum ultimate pull-out capacity from 18 gauge steel: 450 pounds.
- 12. Accessories:
 - a. Bracing, Furring, Bridging, Plates, Gussets, and Clips: Formed sheet steel, thickness as necessary to meet structural requirements for special conditions encountered.

- b. Galvanic Protection: Utilize tapes and other methods as necessary to separate and prevent contact between dissimilar metals.
 - c. Pre-finished Moldings: To be made to match profiles shown on details and drawings.
- 13. Fasteners: Stainless steel fasteners suitable for attaching to specified substrate. TS 200 Concealed fastener application.
- 14. Sealants: In accordance with Section 07 92 00.
- 15. Accessories: Panel manufacturer's standard accessories as required by project conditions.
- D. Accessories: Unless otherwise specified, provide components required for a complete wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, seam covers, flashings, louvers, sealants, gaskets, fillers, closure strips, and similar items. Match materials and finishes of panels.
 - 1. Closure Strips: Custom metal closure strips. Cut or premold to match configuration of panels. Provide closure strips where indicated or necessary to ensure weathertight construction.
 - 2. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.
 - 3. Joint Sealant: One-part elastomeric polyurethane, polysulfide, or silicone-rubber sealant as recommended by panel manufacturer.

2.2 PANEL FABRICATION

- A. General: Fabricate and finish panels and accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Apply coating or other permanent separation materials on concealed panel surfaces where panels would otherwise be in direct contact with substrate materials that are noncompatible or could result in corrosion or deterioration of either materials or finishes.
- C. Fabricate panel joints with captive gaskets or separator strips that provide a tight seal and prevent metal-to-metal contact, in a manner that will minimize noise from movements within panel assembly.

2.3 FLUID-APPLIED VAPOR PERMEABLE AIR/WATER BARRIER MEMBRANES

- A. Fluid-Applied Vapor Permeable Barrier Membrane: Spray or trowel applied membrane. At joints, provide membrane joint tape and termination bar recommended by manufacturer.
- B. Transition Materials: To provide an air and vapor barrier between the membrane and adjacent materials, provide transition materials consisting of extruded low-modulus silicone sheet and silicone sealant designed to adhere to polyethylene side of membrane and adjacent material.

- C. Accessory Materials: Provide accessory items such as primers, cleaners, and termination treatments as recommended by air barrier membrane manufacturer as required to install a continuous membrane and interface with adjacent materials and construction.

2.4 BOARD-TYPE INSULATION AT RAIN SCREEN WALLS

- A. See Section 07 21 00 Thermal Insulation

PART 3 - EXECUTION

3.1 AIR/WEATHER BARRIER INSTALLATION

- A. Strictly comply with air and vapor barrier membrane manufacturer's printed instructions, approved submittals and the following:
 - 1. Apply materials within manufacturer's requirements for temperature and weather conditions.
 - 2. Do not apply to wet or frozen substrates.
 - 3. Do not allow contamination with dust or dirt.
 - 4. Seal completely at edges, perimeter and penetrations.
 - 5. Apply primer if recommended by manufacturer.
- B. Protect installed work from damage due to harmful weather exposures, physical abuse, and other causes.
- C. Provide temporary protection over air and vapor barrier membrane if materials covering air and vapor barrier membrane will not be installed within manufacturer's recommended time limit for exposure.
- D. Repair damage to air and vapor barrier membrane caused by construction activities or subsequent work prior to covering.

3.2 INSULATION INSTALLATION

- A. General Installation Requirements: Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section.
- A. Clean substrates and remove projections which could puncture vapor barriers.
- B. Extend insulation over entire area indicated to be insulated.
- C. Fit tightly around penetrations and obstructions. Fill all holes, gaps and voids including voids and shim spaces at door and window perimeters.
- D. Do not over compress insulation.
- E. Provide insulation in one layer with tightly butted edges, unless indicated otherwise.

- F. Adhere board-type insulations to clean substrate with spot application of adhesive compatible with adjacent materials and approved by the insulation manufacturer.

3.3 PANEL INSTALLATION

- A. General: Comply with support framing and panel manufacturers written instructions and recommendations for installation, as applicable to project conditions and supporting substrates. Anchor panels and other components of the Work securely in place, with provisions for thermal and structural movement.
 - 1. Field cutting exterior panels is not permitted.
 - 2. Install panels with concealed fasteners.
 - 3. Locate and space exposed fasteners in true vertical and horizontal alignment. Use proper tools to obtain controlled, uniform compression for positive seal without rupture of neoprene washer.
- B. Accessories: Install components required for a complete wall panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, seam covers, flashings, louvers, sealants, gaskets, fillers, closure strips, and similar items.
- C. Joint Sealers: Maintain integrity of air/weather barrier. Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of the completed wall panel assemblies.
- D. Installation Tolerances: Shim and align panel units within installed tolerance of 1/4 inch in 20 feet on level, plumb, and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.4 CLEANING AND PROTECTING

- A. Damaged Units: Replace panels and other components of the Work that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.
- B. Cleaning: Remove temporary protective coverings and strippable films, if any, as soon as each panel is installed. On completion of panel installation, clean finished surfaces as recommended by panel manufacturer and maintain in a clean condition during construction.

END OF SECTION 07 46 46

SECTION 07 53 23

EPDM ROOFING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. All Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this section.

1.2 DESCRIPTION OF WORK

- A. Provide single ply membrane roofing system as indicated on the Drawings and as specified herein, including but not limited to the following:
 - 1. Fully adhered EPDM membrane.
 - 2. Roof flashings.
 - 3. Vapor retarder.
 - 4. Tapered and nontapered roof insulation.
 - 5. Cover board.
 - 6. PVC walkway system.
 - 7. All other roofing work indicated.
- B. Comply with the requirements of the roof manufacturer's Specifications, the technical Project Specifications, and/or Industry Standards; in the case of conflict, the more stringent shall apply. Refer to Construction Drawings for detailed requirements.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's printed product data, specifications, standard details, installation instructions, use limitations and recommendations for each material used. Provide certifications that materials and systems comply with specified requirements.
- B. Shop Drawings: Provide large scale shop drawings for layout, installation, and fabrication of all parts of the work. Provide plans and details of anchorage, connections and accessory items.
 - 1. Show slope-to-drain plan of roof. Indicate slopes, valleys, crickets, and drain details.
 - 2. Submit shop drawings showing tapered and nontapered insulation layout.
 - 3. Submit shop drawings showing complete layout of walkway pads.
 - 4. Show all roof penetrations and flashing details; details shall depict conditions on the Contract Documents and shall not be standard catalog details.
- C. Test Reports: Provide certified reports for all specified tests.
- D. Contractor's Review: Before commencing work, submit signed statement that Contract Documents have been reviewed with a qualified representative of supplier/manufacturer,

and that selected materials and construction are proper, compatible, and adequate for application shown.

- E. Certification: Upon completion of work of this Section, submit certification by roof manufacturer acknowledging that all work performed is acceptable and that the roof meets warranty.

1.4 QUALITY ASSURANCE

- A. Fire Resistance Classifications: Unless otherwise indicated, provide single ply membrane roofing system certified as UL Class A for external fire exposure, and FM Class 1 for Internal fire exposure.
- B. FM Uplift Criteria: Design and construct roof systems for the FM uplift criteria of 1-90.
- C. FMRC Approval: Roofing system shall be FMRC Approved.

1.5 WARRANTY

- A. Type/Term:
 - 1. Provide 30-year Roofing System Warranty. Warranty shall include membrane, roof sheathing, cover board and insulations, all associated flashings, metal, drains and membrane accessories.
- B. Coverage
 - a. Limit of liability: No Dollar Limitation
 - b. Scope of coverage: Repair any leak in the roof system caused by the ordinary wear and tear of the elements, unintentional and occasional damage to the membrane as a result of normal rooftop inspection, maintenance or service, manufacturing defect in materials, and the workmanship used to install these materials.

PART 2 PRODUCTS

2.1 ROOF SYSTEM

- A. Elastomeric Sheet Roofing: A total system of compatible materials designed for fully adhered installation consisting of a sheet membrane, vulcanized and nonvulcanized flashing sheet, seam tapes, adhesives and all other materials required for a complete installation, except as otherwise specified all produced by the same manufacturer with a minimum of 5 years of successful applications.
 - 1. Sheet Membrane: ASTM D 4637, Type I, EPDM rubber, black, 90 mils thick; fire-retarded: Carlisle Syntec's Sure-Seal, Firestone's RubberGard.
 - 2. Unvulcanized Flashing: ASTM D 4811, Type I.
 - 3. Adhesives: Contact type butyl recommended by the sheet manufacturer for bonding EPDM to insulation and substrates.
 - 4. Solvents and Primers: As recommended by the sheet manufacturer for cleaning and

- priming surfaces, diluting adhesive. Gasoline is not permitted for cleaning.
- 5. Seam Splicing Tape and Cover Tape: As recommended by the sheet manufacturer.
- 6. Sealers; pourable: 2-part urethane, pourable grade, as recommended by the sheet manufacturer.
- 7. Sealers; trowelable: water seal mastic.

2.2 INSULATION AND ACCESSORIES

- A. Isocyanurate insulation boards with glass fiber facers: ASTM C 1289, Type II, Class 1, glass-fiber mat facer on both major surfaces equal to Firestone ISO 95+ GL. Maximum size: 4' x 4'. Each board shall be factory marked with the manufacturer's name and product name. Flat boards shall be 2.0" thick or as required to provide the indicated total thickness and tapered boards tapered to the slope indicated from a minimum one inch at drains and gutters. Taper crickets 1/2" per ft.
- B. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drains, gutters and eaves. Fabricate to slopes indicated.
- C. Cover board: Roofing manufacturer's recommended cementitious cover board
 - 1. 1/2" thick
 - 2. Density 12.0 pcf.
 - 3. Compressive strength: 180 psi
- D. Adhesives: Single-component foam: OlyBond as manufactured by Olympic Fastener, Weather-Tite One Step Foamable Adhesive as manufactured by Millenium Adhesive products, Inc. or equal approved by the membrane manufacturer and FMG for adhering underlay and insulation boards to withstand the specified uplift force.
- E. Flexible Walkways: Factory-formed, PVC walkway pad, 9/16" thick, Cross Grip PVC as manufactured by Plastex and as acceptable to roofing membrane manufacturer. Provide walkway pad accessories including snap track, edging and connectors as required for complete installation.
 - 1. Composition: Flexible Polyvinyl Chloride (PVC)
 - 2. Drainage: DIN 51130: V10
 - 3. Flammability: UL 94 HB Self Extinguished (material ignited but stopped burning prior to reaching the timing zone) / No.
 - 4. Burn Rate: UL 214 self extinguished but did not reach the burn point
 - 5. Made from non-porous PVC that's naturally resistant to bacteria growth.
 - 6. Slip resistance: ASTM F 1677 - Dry/Wet: 1.0/0.9
 - 7. Thermal: Designed to function at temperatures from -9°F and up to +140°F.
 - 8. UV light Resistant to PVC degradation.

2.4 RELATED MATERIALS

- A. Bonding adhesive shall be as recommended by manufacturer. Adhesive shall be compatible with all materials to which the elastomeric membrane is to be bonded. Provide products that meet or exceed the VOC limits of South Coast Air Quality Management District Rule No. 1168.

- B. Splicing cement shall be as recommended by membrane manufacturer.
- C. Lap sealant for sealing the exposed edge of the splices shall be trowel on gun consistency, as recommended by membrane manufacturer.
- D. Water cutoff mastic shall be as recommended by membrane manufacturer.
- E. Night sealer shall be as recommended by membrane manufacturer.
- F. Pourable sealer shall be as recommended by membrane manufacturer.
- G. Prefabricated elastomeric accessories (pipe seals, inside and outside corners, lap splice tape, etc.) shall be as manufactured and recommended by membrane manufacturer.
- H. Nailer strips: Structural Grade No. 2 or better Southern Pine, Douglas fir or Exterior Grade plywood.
- I. Ballast: Light color rounded water-worn gravel.
- J. Miscellaneous Items: Provide all other roofing materials as required to meet specified design and performance requirements.
- K. Separator Sheet: As recommended by manufacturer.
- L. Fabric Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric mat; water permeable and resistant to UV-light degradation; of type and weight recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Surfaces to receive roofing materials shall be rigid, tight, clean, dry, smooth, free of scale, dust, oil, or other foreign matter, and also free of frost or the effects of freezing. Thoroughly clean surfaces to remove loose particles immediately before application of subsequent materials. Do not apply roofing materials over wet subsurfaces.
- B. Where surface joints at roof and wall substrates exceed 1/4 in. width, fill flush with surface with pourable sealer before proceeding with the installation.
- C. Do not leave unfinished roof areas uncovered overnight or during inclement weather.
- D. Work shall conform to manufacturer's published specifications, and the published standards of UL and Factory Mutual. Roof shall be made permanently weatherproof in continuous operation, including connection to flashing and gravel stops provided under Section 07 60 00,

FLASHING AND SHEET METAL.

1. Rated roof system shall be constructed in accordance with UL Design numbers, as indicated.
- E. Provide manufacturer's recommended weatherproofing method at projections, connections to sheet metal gravel stops and flashings and at other special conditions.
- F. Special Cautions:
1. Do not use oil-based or plastic roof cement.
 2. Do not subject elastomeric materials to contact with petroleum, grease, oil, solvents, vegetable or mineral oil, nor animal fat. Prevent contact with hot pipes, and ducts.
 3. Cements and bonding adhesive contain petroleum distillates and are extremely volatile and flammable. Avoid breathing vapors and do not use near fire or flame.
 4. Ensure that splicing and bonding surfaces are dry during installation.
 5. Do not dilute primers, adhesives, coatings or sealers.
- G. Do not damage or stain surrounding work. Remove stains and repair damage immediately, as work progresses, as part of work of this Section.

3.3 ROOF INSULATION AND COVER BOARD

- A. Follow sequence coding. Install only as much insulation daily as can be covered with roofing by close of work. Do not expose materials to rain or snow, nor overnight. Replace material that becomes wet.
- B. Install cover boards in accordance with membrane manufacturers recommendations and meeting the requirements for rating agency approvals.
- C. Roof Insulation: Install tapered and nontapered roof insulation to roof deck in accordance with manufacturer's recommendations and as specified in this Section and indicated on Drawings, meeting the requirements for FM approval.
- D. Install tapered insulation and crickets as indicated on approved shop drawings to provide required roof slope and pitch to drains.
- E. Feather or taper insulation around drains for smooth transition between roof surface and drain clamp ring.

3.4 ELASTOMERIC ROOFING

- A. Install fully adhered single ply membrane roofing system in conformance with approved Submittals, including manufacturer's published instructions, and in accordance with FM requirements.
- B. Seaming: weld the membrane seams a minimum of 1-1/2 in. wide with manufacturer's

recommended welder.

3.5 WALKWAY PADS

- A. Install walkway pad system in conformance with approved Submittals, including manufacturer's published instructions, and in accordance with FM requirements.

3.6 ROOF PENETRATIONS

- A. Coordinate with other trades to seal penetrations for pipes, conduit, lightning protection, flues, equipment supports, etc.
- B. Coordinate and cooperate with plumbing subcontractor for installation of roof drain assemblies.

3.7 FIELD QUALITY CONTROL

- A. A roof inspection is required by manufacturer before warranty is issued.
- B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect. Notify Architect or Owner one week in advance of date and time of inspection.
- C. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 CLEANING

- A. Keep surrounding surfaces clean as work progresses.
- B. Remove cartons, debris, emptied containers, and other rubbish as work progresses, and at completion of work of this Section. Legally dispose of rubbish off site.

END OF SECTION

SECTION 07 60 00

FLASHING AND SHEET METAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. The work of this Section includes, but is not limited to:

- 1. Metal and membrane flashings.
- 2. Metal copings.
- 3. Scuppers.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations for each product used.
- B. Shop Drawings: Provide large scale shop drawings for fabrication, installation and erection of all parts of the work. Provide large scale plans, elevations, and details of profiles, joints, seams, anchorages, connections and accessory items. Include statement that materials are physically compatible.
- C. Verification Samples: Submit representative samples of each material that is to be used in the work, showing the full range of color and finish variations expected. Provide samples having minimum area of 144 square inches.

1.4 QUALITY ASSURANCE

- A. Comply with applicable requirements, recommendations and details of SMACNA *Architectural Sheet Metal Manual*.

1.5 SEQUENCING AND SCHEDULING

- A. Conference: Convene a pre-installation conference to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.
- B. Perform work of this section in coordination with other sections to provide the highest quality work which best fulfills the intent requirements of this work.

PART 2 - PRODUCTS

2.1 FLASHING AND SHEET METAL

- A. Membrane Flashing: W. R. Grace Perm-A-Barrier with P3000 primer, CCW 705 TWF by Carlisle Coatings & Waterproofing, or equal by Durawal or Mirafi. Use waterbased primer only if VOC regulations prohibit use of P3000 primer. Use for jamb flashing, cavity wall flashing and as indicated.
- B. Embedded Through Wall Flexible Flashing: Copper-Laminated Flashing: 7-oz./sq. ft. copper sheet bonded between two layers of glass-fiber cloth. Use only where flashing is fully concealed in masonry. Basis-of-design Product: Mortar Net Solutions; TotalFlash unitized flashing and cavity drainage system or comparable product by one of the following:
Advanced Building Products Inc.
York Manufacturing, Inc.
- C. Exposed Flashing, Counter Flashing and Copings: Aluminum, fluoropolymer finish. minimum 0.050 inch thick, unless otherwise indicated.

2.2 MISCELLANEOUS MATERIALS

- A. Fasteners: Match material being fastened for both type of material and finish.
- B. Isolation Coating: SSPC paint 12.
- C. Accessories: Provide all clips, cleats, straps, anchors and similar items necessary to properly complete the work. Provide accessories that are compatible with sheet metal materials used and which are of sufficient size and gage to perform as intended.

2.3 FABRICATION

- A. Shop fabricate work to the greatest extent possible. Fabricate work to be truly straight, plumb, level and square, and to provide the best possible watertight, weatherproof performance with expansion provisions in running work.
- B. Provide work to sizes, shapes, and profiles indicated on approved shop drawings. Comply with referenced standards. Minimize oil-canning, buckling, tool marks and other defects.
- C. Make work with uniform, watertight joints. Make seams as inconspicuous as possible.
- D. Isolate dissimilar materials with isolation coating or other permanent separation acceptable to the Architect.
- E. Scuppers: Fabricate scuppers of dimensions required with closure flange trim to exterior, 4 in. wide wall flanges to interior, and base extending 4 in. beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.

PART 3 - EXECUTION

3.1 INSPECTION

- A. The Installer shall examine substrates, supports, and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means Installer accepts substrates and conditions.

3.2 INSTALLATION

- A. Install flashing in continuous uninterrupted manner to accomplish 'intent' complete with all transitions, laps, splices, folds, seams necessary to ensure the diversion of water to the exterior. Work in close coordination with installation of exterior masonry, roofing, window, and joint sealer systems.
 - 1. Apply materials within manufacturer's requirements for temperature and weather conditions.
 - 2. Do not apply to wet or frozen substrates.
 - 3. Do not allow contamination with dust or dirt.
 - 4. Seal completely at edges, perimeter and penetrations.
- B. Strictly comply with manufacturer's instructions and recommendations and standard details and recommendations of SMACNA, except where more restrictive requirements are specified in this section. Locked and sealant locked joints as indicated on the Drawings.
- C. Securely anchor work, but allow for thermal movement and building movement. Use concealed fasteners to the greatest extent possible. Install work to be permanently weatherproof and watertight. Provide continuous cleats at all edge conditions.
- D. Bed metal flashing work in thick coating of roofing cement for watertight performance. Do not permit roofing cement to run or drip out from under sheet metal work under any conditions.
- E. Provide reglets where indicated and where required. Coordinate installation with related and adjacent work.
- F. Provide through-wall flashing at masonry walls. Overlap adjacent pieces of flashing minimum 2" and roll all overlaps with steel hand roller. Trim bottom edge of flashing minimum of 1/4" back from exposed face of the building. Staple vertical and horizontal joints. Apply a bead of sealant along top edge of flashing membrane and along seams and cuts as necessary and as recommended by manufacturer.
 - 1. Fasten membrane and install in horizontal strips with 3 feet wide by 10inch long pieces, starting at the bottom of the wall. Fasten top edge 16 to 24 inches on center. Subsequent strips of membrane shall lap over the fasteners about 2 inches. Corners shall

be reinforced with 18 inch wide membrane strips before applying the membrane.

- G. Provide flashing at every obstruction to the downward flow of water. Design and install flashing to control and divert water to the exterior. Form at least 4" high end pans above lintels and similar conditions to extend the entire length of the lintel where possible. Flashing shall extend 4" minimum beyond end of lintel before it is panned (dammed).
- H. Soldering to existing sheet metal: Thoroughly mechanically clean surface of existing materials to remove all dirt, coatings, oxidation and material that would impede complete bonding of solder to metal. Surface should be clean bright copper. Verify remaining existing sound copper sheet is at least .016 inches in thickness. Apply tin bearing flux to surfaces to receive solder.

END OF SECTION

SECTION 07 81 00

APPLIED FIREPROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. This Section includes the following:
 - 1. Sprayed-on cementitious fireproofing for concealed applications

1.3 SUBMITTALS

- A. Product Data: For each fire-resistive product specified.
 - B. Shop Drawings: Provide structural framing plans indicating the following:
 - 1. Locations and types of surface preparations required before applying sprayed fire-resistive material.
 - 2. Extent of sprayed fire-resistive material for each construction and fire-resistance rating, including the following:
 - a. Applicable fire-resistive design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
 - b. Minimum thicknesses needed to achieve required fire-resistance ratings of structural components and assemblies.
 - c. Designation of restrained and unrestrained conditions based on definitions in ASTM E 119-07a.
 - 3. Treatment of sprayed fire-resistive material after application.
 - C. Product Certificates: Signed by manufacturer of sprayed fire-resistive material certifying that the products furnished comply with requirements and is asbestos-free.
 - D. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- ##### **1.4 QUALITY ASSURANCE**
- A. Installer Qualifications: Engage an experienced installer certified, licensed, or otherwise qualified by sprayed fire-resistive material manufacturer as having the necessary experience, staff, and training to install manufacturer's products according to specified requirements. A

manufacturer's willingness to sell its sprayed fire-resistive materials to Contractor or to an installer engaged by Contractor does not in itself confer qualification on the buyer.

- B. Testing Agency Qualifications: An independent testing and inspecting agency with the experience and capability to conduct the testing indicated without delaying the Work, as documented according to ASTM E 699-03.
- C. Required Testing for Cementitious Fireproofing: Refer to Paragraph 3.5.
- D. Source Limitations: Obtain each type of sprayed fire-resistive material from one source and by a single manufacturer.
- E. Fire-Test-Response Characteristics: Provide sprayed fire-resistive materials and assemblies identical to those tested for the following fire-test-response characteristics per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify packages (bags) containing sprayed fire-resistive material with appropriate markings of applicable testing and inspecting agency.
 - 1. Fire-Resistance Ratings: As indicated by reference to fire-resistive designs listed in UL's "Fire Resistance Directory," or in the comparable publication of another testing and inspecting agency acceptable to authorities having jurisdiction, for sprayed fire-resistive material serving as direct-applied protection, tested per ASTM E 119-07a.
 - 2. Surface-Burning Characteristics: As indicated for each sprayed fire-resistive product required, tested per ASTM E 84-08.
- F. Provide products containing no detectable asbestos as determined according to the method specified in 40 CFR, Part 763, Subpart E, Appendix E, Section 1, "Polarized Light Microscopy."

1.5 PERFORMANCE REQUIREMENTS

A. MINIMUM FIRE RESISTANCE REQUIREMENTS

Roof Construction including beams, trusses, and framing, and roof deck

1 hour

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to Project site in original, unopened packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; shelf life, if applicable; and fire-resistance ratings applicable to Project.
- B. Use materials with limited shelf life within period indicated. Remove from Project site and discard materials whose shelf life has expired.
- C. Store materials inside, under cover, aboveground, so they are kept dry until ready for use. Remove from Project site and discard materials that have deteriorated.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations for Cementitious Materials: Do not apply sprayed fire-resistive material when ambient or substrate temperatures are 5 deg C (40 deg F) or lower, unless temporary protection and heat is provided to maintain temperatures at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of sprayed fire-resistive material. Use natural means or, where this is inadequate, forced-air circulation until fire-resistive material dries thoroughly.

1.8 SEQUENCING

- A. Sequence and coordinate application of sprayed fire-resistive materials with other related work specified in other Sections to comply with the following requirements:
 - 1. Provide temporary enclosures for interior applications to prevent deterioration of fire-resistive material due to exposure to unfavorable environmental conditions.
 - 2. Avoid unnecessary exposure of fire-resistive material to abrasion and other damage likely to occur during construction operations subsequent to its application.
 - 3. Do not apply fire-resistive material to metal roof deck substrates until roofing has been completed; prohibit roof traffic during application and drying of fire-resistive material.
 - 4. Do not begin applying fire-resistive material until clips, hangers, supports, sleeves, and other items penetrating fire protection are in place.
 - 5. Do not install enclosing or concealing construction until after fire-resistive material has been applied, inspected, tested, and corrections have been made to defective applications.

PART 2 - - PRODUCTS

2.1 LOW DENSITY SPRAYED FIRE-RESISTIVE MATERIALS

- A. General: For low-density applications of sprayed fire-resistive materials, provide manufacturer's standard products complying with requirements indicated in this Article for material composition and physical properties representative of installed products.
- B. Material Composition: Cementitious sprayed fire-resistive material consisting of factory-mixed, dry formulation of gypsum or portland cement binders and lightweight aggregates mixed with water at Project site to form a slurry for conveyance and application.
- C. Physical Properties: Minimum values, unless otherwise indicated, or higher values required to attain designated fire-resistance ratings, measured per standard test methods referenced with each property listed as follows:
 - 1. Dry Density: 15 lb/cu. ft. for average and individual densities of specified products regardless of density indicated in referenced fire-resistive design, or greater if required

to attain fire-resistance ratings indicated, per ASTM E 605-93(2006) or AWCI Technical Manual 12-A, Appendix A, "Alternate Method for Density Determination."

2. Thickness: Provide minimum average thickness required for fire-resistive design indicated according to the following criteria, but not less than 0.375 inch, per ASTM E 605.
 - a. Where the referenced fire-resistive design lists a thickness of 1 inch or greater, the minimum allowable individual thickness of sprayed fire-resistive material is the design thickness minus 0.25 inch.
 - b. Where the referenced fire-resistive design lists a thickness of less than 1 inch but more than 0.375 inch, the minimum allowable individual thickness of sprayed fire-resistive material is the greater of 0.375 inch or 75 percent of the design thickness.
 - c. No reduction in average thickness is permitted for those fire-resistive designs whose fire-resistance ratings were established at densities of less than 15 lb/cu. ft.
3. Bond Strength: 389 lbs/sq. ft. per ASTM E 736-00(2006) under the following conditions:
 - a. Field test sprayed fire-resistive material that is applied to flanges of wide-flange structural-steel members on surfaces matching those that will exist for remainder of steel receiving fire-resistive material.
 - b. If surfaces of structural steel receiving sprayed fire-resistive material are primed or otherwise painted, perform series of bond tests specified in UL's "Fire Resistance Directory" for coating materials.
 - c. Minimum thickness of sprayed fire-resistive material tested in laboratory shall be 0.75 inch.
4. Compressive Strength: 2,340 lbs/sq. ft. as determined in the laboratory per ASTM E 761-92(2005). Minimum thickness of sprayed fire-resistive material tested shall be 0.75 inch and minimum dry density shall be as specified, but not less than 15 lb/cu. ft..
5. Corrosion Resistance: No evidence of corrosion per ASTM E 937-93(2005).
6. Deflection: No cracking, spalling, delamination, or the like per ASTM E 759-92(2005).
7. Effect of Impact on Bonding: No cracking, spalling, delamination, or the like per ASTM E 760-92(2005).
8. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours per ASTM E 859-93(2006). For laboratory tests, minimum thickness of sprayed fire-resistive material is 0.75 inch, maximum dry density is 15 lb/cu. ft., test specimens are not prepured by mechanically induced air velocities, and tests are terminated after 24 hours.
9. Hardness: 40 per ASTM D 2240-05.
10. Asbestos Content: Asbestos free.

11. Resistance to mold: The fireproofing material shall be formulated at the time of manufacturing with a mold inhibitor. Fireproofing material shall be tested in accordance with ASTM G 21 and shall show resistance to mold growth for a period of 21 days for general use and 60 days for materials to be installed in plenums.
- D. Fire-Test-Response Characteristics: Provide sprayed fire-resistive materials with the following surface-burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
 1. Flame Spread: 0.
 2. Smoke Development 0.
- E. Products: Subject to compliance with requirements, provide one of the following:
 1. Monokote Type MK6/HY; W.R. Grace & Co.--Conn., Construction Products Div. or 15HY by Carbolite , 5GP/5EF by Southwest Vermiculite, or CAFCO 300 by Isolatek.

2.5 AUXILIARY FIRE-RESISTIVE MATERIALS

- A. General: Provide auxiliary fire-resistive materials that are compatible with sprayed fire-resistive materials and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistive designs indicated.
- B. Substrate Primers: For use on each substrate and with each sprayed fire-resistive product, provide that complies with one or more of the following requirements:
 1. Primer's bond strength complies with requirements specified in UL's "Fire Resistance Directory" for coating materials based on a series of bond tests per ASTM E 736.
 2. Primer is identical to those used in assemblies tested for fire-test-response characteristics of sprayed fire-resistive material per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Adhesive for Bonding Fire-Resistive Material: Product approved by manufacturer of sprayed fire-resistive material.
- D. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required to comply with fire-resistive designs indicated and fire-resistive product manufacturer's written recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive sprayed fire-resistive material.

PART 3 - - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, to determine whether they are in satisfactory condition to receive sprayed fire-resistive material. A substrate is in satisfactory condition if it complies with the following:
 - 1. Substrates comply with requirements in the Section where the substrate and related materials and construction are specified.
 - 2. Substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt, or other foreign substances capable of impairing bond of fire-resistive material with substrate under conditions of normal use or fire exposure.
 - 3. Objects penetrating fire-resistive material, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
 - 4. Substrates are not obstructed by ducts, piping, equipment, and other suspended construction that will interfere with applying fire-resistive material.
- B. Conduct tests according to fire-resistive material manufacturer's written recommendations to verify that substrates are free of oil, rolling compounds, and other substances capable of interfering with bond.
- C. Do not proceed with installation of fire-resistive material until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances that could impair bond of fire-resistive material, including oil, grease, rolling compounds, incompatible primers, and loose mill scale.
- B. Prime substrates where recommended in writing by fire-resistive material manufacturer, unless compatible shop primer has been applied and is in satisfactory condition to receive fire-resistive material.
- C. For exposed applications, repair substrates to remove any surface imperfections that could affect uniformity of texture and thickness in finished surface of sprayed fire-resistive material. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.
- D. Cover other work subject to damage from fallout or overspray of fire-resistive materials during application. Provide temporary enclosure as required to confine spraying operations, protect the environment, and ensure maintenance of adequate ambient conditions for temperature and ventilation.

3.3 INSTALLATION, GENERAL

- A. Comply with fire-resistive material manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to convey and spray on fire-resistive material, as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.

- B. Apply sprayed fire-resistive material that is identical to products tested as specified in Part 1 in "Product Test Reports" in "Submittals" Article, with respect to rate of application, accelerator use, topcoats, tamping, troweling, water overspray, or other materials and procedures affecting test results.
- C. Install metal lath, as required, to comply with fire-resistance ratings and fire-resistive material manufacturer's written recommendations for conditions of exposure and intended use. Securely attach lath to substrate in position required for support and reinforcement of fire-resistive material. Use anchorage devices of type recommended in writing by fire-resistive material manufacturer. Attach lathing accessories where indicated or required for secure attachment to substrate. Aluminum lath is not acceptable.
- D. Coat substrates with adhesive before applying fire-resistive material where required to achieve fire-resistance rating or as recommended in writing by fire-resistive material manufacturer for material and application indicated.
- E. Extend fire-resistive material in full thickness over entire area of each substrate to be protected. Unless otherwise recommended in writing by fire-resistive material manufacturer, install body of fire-resistive covering in a single course.
- F. Spray apply fire-resistive materials to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by manufacturer.

3.4 INSTALLING SPRAYED FIRE-RESISTIVE MATERIALS

- A. Apply fire-resistive material in thicknesses and densities indicated, but not less than those required to achieve fire-resistance ratings designated for each condition, and comply with requirements for thickness specified in Part 2 "Sprayed Fire-Resistive Materials" Article.
 - 1. Apply water overspray to sprayed-fiber fire-resistive material as required to obtain designated fire-resistance rating.
 - 2. For steel beams and bracing, provide a thickness of not less than the thickness required by code.
- B. Provide a uniform finish complying with description indicated for each type of material and matching finish approved for field-erected mockup.

3.5 FIELD QUALITY CONTROL

- C. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and to prepare test reports.
 - 1. Testing and inspecting agency will interpret tests and state in each report whether tested work complies with or deviates from requirements.
- D. Testing and inspecting of completed applications of sprayed fire-resistive material will take place in successive stages, in areas of extent and using methods as follows. Do not proceed

with application of fire-resistive material for the next area until test results for previously completed applications of fire-resistive material show compliance with requirements.

1. Extent: For each 1000-sq. ft. area, or partial area, on each floor, testing and inspecting agency will evaluate the following characteristics. Tested values must equal or exceed values indicated and values required for approved fire-resistance design.
 - a. Thickness for Roofs and Walls: From the average of 10 measurements from a 144-sq. in. sample area, with sample width of not less than 6 inches per ASTM E 605.
 - b. Thickness for Structural Frame Members: From a sample of 25 percent of structural members per floor, taking 9 measurements at a single cross section for structural frame beams or girders, 7 measurements of a single cross section for joists and trusses, and 12 measurements of a single cross section for columns per ASTM E 605.
 - c. Density for Floors, Roofs, Walls, and Structural Frame Members: At frequency and from sample size indicated for determining thickness of each type of construction, per ASTM E 605 or AWCI Technical Manual 12-A, Appendix A, "Alternate Method for Density Determination."
 - d. Bond Strength for Floors, Roofs, Walls, and Structural Framing Members: Cohesion and adhesion at frequency and from sample size indicated for determining thickness of each type of construction, per ASTM E 736.
 2. When testing discovers applications of fire-resistive material not in compliance with requirements, testing and inspecting agency will perform additional random testing to determine extent of noncompliance.
- E. Remove and replace applications of fire-resistive material where test results indicate that they do not comply with specified requirements for cohesion and adhesion or for density, or both.
 - F. Apply additional fire-resistive material per manufacturer's written instructions where test results indicate that thickness does not comply with specified requirements.
 - G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 CLEANING, PROTECTING, AND REPAIR

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- B. Cure exposed cementitious sprayed fire-resistive material according to product manufacturer's written recommendations to prevent premature drying.
- C. Protect fire-resistive material, according to advice of product manufacturer and Installer, from damage resulting from construction operations or other causes so fire protection will be without damage or deterioration at the time of Substantial Completion.

- D. Coordinate application of fire-resistive material with other construction to minimize the need to cut or remove fire protection. As installation of other construction proceeds, inspect fire-resistive material and patch any damaged or removed areas. Perform patching prior to concealing fire protection above other finish materials.
- E. Repair or replace work that has not been successfully protected.

END OF SECTION 07 81 00

SECTION 07 84 00

FIRESTOPPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. Provide firestopping systems to prevent the passage of flame and the products of combustion through concealed spaces and openings as required by code including, but is not limited to, the following:
 - 1. Above wall or partitions indicated to extend to underside of structure above.
 - 2. Concealed furring spaces behind finished surfaces.
 - 3. Locations at pipes, conduits, ducts and other construction which passes through fire-rated assemblies.
 - 4. Openings related to systems that penetrate or interrupt fire-rated assemblies.

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to:
 - 1. Section 07 92 00, Joint Sealants.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations for each material used. Provide certifications stating that materials comply with requirements.
- B. Test Reports: Submit manufacturers' certified test reports and general certification that products meet requirements.
- C. Mock-Up: Prior to installation of firestopping, provide a mock-up of each type of firestopping system proposed for use for approval. Accepted mock-ups may be incorporated in the work.

1.5 QUALITY ASSURANCE

- A. Source: For each type of material required for the work of this section, provide primary materials which are the products of one manufacturer. Provide secondary materials which are acceptable to the manufacturers of the primary materials.
- B. Installer: Engage an experienced installer with three years documented experience acceptable to firestopping manufacturer.
- C. Asbestos-Free Products: Provide firestopping products containing no detectable asbestos as determined by method specified in 40CFR Part 763, Subpart F, Appendix A, Section 1, "Polarized Light Microscopy."

1.6 TESTS

- A. Fire-Resistance: Provide materials and construction which are identical to assemblies whose fire-resistance rating has been tested in compliance with ASTM E119-07a, UL 263, ANSI A2.1, or NFPA 251 by independent agencies acceptable to the Architect and authorities having jurisdiction. Provide - Perimeter Fire Barrier Systems for firesafing at curtainwalls tested per UL2079 utilizing UL's Intermediate Scale Multistory Apparatus (ISMA).
- B. Burning Characteristics: Provide materials whose surface burning characteristics, when tested in compliance with ASTM E84-08 are as follows:
 - 1. Flame Spread: Not more than 25.
 - 2. Smoke Developed: Not more than 25.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturers' instructions and recommendations. Protect from damage.
- B. Sequence deliveries to avoid delays, but minimize on-site storage.

1.8 SEQUENCING AND SCHEDULING

- A. Conference: Convene a pre-installation conference to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.
- B. Perform work of this section and other sections in proper sequence so that this work will not be damaged and will be installed prior to installation of enclosing or concealing work.

PART 2 - PRODUCTS

2.1 FIRESTOPPING, GENERAL

- A. Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.
- B. Accessories: Provide components for each firestopping system that are needed to install fill materials and to comply with "System Performance Requirements" article in Part 1. Use only components specified by the firestopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire-resistance-rated systems. Accessories include but are not limited to the following items:
 - 1. Permanent forming/damming/backing materials including the following:
 - a. Semirefractory fiber (mineral wool) insulation.
 - b. Ceramic fiber.
 - c. Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.
 - d. Fire-rated formboard.
 - e. Joint fillers for joint sealants.
 - 2. Temporary forming materials.
 - 3. Substrate primers.
 - 4. Collars.
 - 5. Steel sleeves.
- C. Applications: Provide firestopping systems composed of materials specified in this Section that comply with system performance and other requirements.

2.2 FIRE-SAFING BOARD INSULATION

- A. Provide material tested, listed and labeled by UL and listed by UL in designs similar to applications indicated. Provide semi-rigid, non-asbestos mineral fiber board, rated noncombustible when tested according to ASTM E 136-04:
 - 1. k-Value: 0.25 at 75°F.
 - 2. Thickness: 4 in., unless otherwise indicated, and not less than thickness necessary to obtain required fire-rating.
 - 3. Density: Nominal 4 pcf.
 - 4. Product: U. S. Gypsum Co., Thermafiber Safing Insulation; Partek Insulation, Inc. Paroc Safing Insulation; Fibrex, Inc. FBX Safing Insulation; or approved equal.

2.3 MINERAL WOOL

- A. Provide loose mineral wool, rated noncombustible when tested in accordance with ASTM E 136-04, free of asbestos and glass fiber, and suitable for in-place density of 6 pcf to 12 pcf.

2.4 CAULK AND PUTTY

- A. Provide one of the following products, or Architect approved equal, that meet or exceed specified requirements:
1. Bio Therm; Bio Fireshield.
 2. Fire-Barrier Series; 3M Fire Protection Products.
 3. Flamesafe; International Protective Coatings Corp.
 4. Flame Stop V Putty and Caulking; Flame Stop, Inc.
 5. Fyre Putty; Standard Oil Engineered Materials Company.
 6. Silicone Firestop Foam 2001, and Sealant 2000; Dow Corning Corp.
 7. CLK Adhesive Firestop; Nelson Firestop.
 8. STI SpecSeal S100.
 9. STI Spec Seal AS 200.

2.5 FIRESTOP MORTAR

- A. Prepackaged dry mix composed of a blend of inorganic binders, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogenous mortar.
- B. Provide one of the following products, or Architect approved equal, that meet or exceed specified requirements:
1. Novasit K-10; Bio Fireshield
 2. KBS Mortar Seal; International Protective Coatings Corp.
 3. CMP Firestop Compound; Nelson Firestop.
 4. STI SpecSeal Mortar.

2.6 WRAP STRIPS

- A. Single-component, elastomeric sheet with aluminum foil on one side. Provide one of the following products, or Architect approved equal, that meet or exceed specified requirements:
1. SpecSeal Wrap Strip; STI.
 2. Fire Barrier FS195 Wrap Strip; 3M.
 3. CS2420 Intumescent Wrap, Hilti Construction Chemicals, Inc.

2.7 COMPOSITE BOARDS

- A. Provide one of the following products, or Architect approved equal, that meet or exceed specified requirements:
1. Barrier Sheet Material; 3M.

2.8 MIXING

- A. For those products requiring mixing prior to application, comply with firestopping manufacturer's directions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other procedures needed to produce firestopping products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 INSPECTION

- A. The Installer shall examine substrates, supports, and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means Installer accepts substrates and conditions.

3.2 PREPARATION

- A. Review extent and types of required firestopping with governing authorities before beginning work. Obtain approval of thicknesses and installation methods, including non-typical locations.

3.3 INSTALLATION

- A. Strictly comply with manufacturers' instructions and recommendations, except where more restrictive requirements are specified in this section.
- B. Provide firestopping material and thickness as required to provide indicated ratings. Where not otherwise indicated, comply with UL standard designs. In multiple layer work, offset joints by at least 6". Anchor firestopping using manufacturers' recommended system and in compliance with UL standard designs.
- C. Install firestopping without gaps and voids of any kind. Do not use damaged materials. Remove and replace nonfitting or disturbed work.
- D. All sleeves installed to accommodate future work are to be sealed with properly supported safing insulation. Oversized boxouts, sleeves, and cores are to be filled with grout full depth of concrete with reinforcing, and other support as necessary to secure grout.

3.4 FIELD QUALITY CONTROL

- A. Coordinate installation of firestopping work with other work to minimize cutting and removal of installed fireproofing. As work of other trades is completed, review firestopping work and repair or replace work which has been damaged or removed.

3.5 PROTECTION

- A. Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protections and rework as necessary immediately before final acceptance.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to, the preparation of joints, sealing and filling of joints and curing and protection of completed work.
- B. Provide joint sealants as scheduled in this section and as indicated on the drawings. Before beginning work, obtain Architect's clarification if the extent of each type of sealant and filler is uncertain.
- C. General Extent: Seal all joints as noted and all interior joints, seams, and intersections between dissimilar materials. Provide elastomeric sealant installation with backer rod in all control joints.

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to:
 - 1. Section 07 84 00, Firestopping; fire resistant sealants and caulks.
 - 2. Section 08 81 00, Glass Glazing; glazing sealants and gaskets.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation and curing instructions, use limitations and recommendations for each material used. Provide certifications stating that materials comply with requirements and are compatible with adjacent materials selected for use including flashings.
- B. Initial Selection Samples: Submit samples showing complete range of colors and finishes available for each material used.
- C. Test Reports: Submit test reports by an independent testing laboratory for adhesion, compatibility and staining for all sealant-substrate combinations.
- D. Quality Control
 - 1. Installer's Qualification Data.

2. Manufacturer's Field Advisor Data.

1.5 INTENT

- A. Performance and Design Requirements for Sealants: Provide sealants to maintain long term 20 year minimum air tight and water tight seals. No cohesive or adhesive failures, nor cracking or bubbling of sealant surfaces are permitted. Provide sealants certified by sealant manufacturer to be capable of accommodating the full range of manufacturing tolerances, field erection tolerances, building deflections, and all other movements.
 - 1. Interior Work: Interior work is intended to seal and fill all cracks, voids and gaps in the work, usually, but not always, located between dissimilar materials. All gaps between walls and plumbing fixtures, countertops and permanently anchored furnishings shall be provided with a continuous tooled seal.

1.6 QUALITY ASSURANCE

- A. Source: For each type of sealant and filler material required for the work of this section, provide primary materials which are the products of one manufacturer. Provide secondary materials which are acceptable to the manufacturers of the primary materials.
- B. Mock-Ups: Before beginning primary work of this section, provide 10 linear feet mock-ups of each type of sealing and filler work at locations acceptable to Architect and obtain Architect's acceptance of visual qualities. Protect and maintain acceptable mock-ups throughout the work of this section to serve as criteria for acceptance of this work. Acceptable mock-ups may be incorporated into the finished work.
- C. Preconstruction Testing: Sealants shall be tested for compatibility, non-staining, no effect of wetting characteristics of substrates and adhesion with substrates with which it is expected to come in contact. Test and validate sealants used for exterior weather sealing per the Sealant Waterproofing Restoration Institute (SWRI).
- D. Construction Sealant Adhesion Tests: Periodically test sealants in place for adhesion using methods recommended by sealant manufacturer. Promptly replace all sealant which does not adhere or which fails to cure properly.
- E. Installer's Qualifications: The persons installing the sealants and their supervisor shall be personally experienced in the installation of sealants and shall have been regularly employed by a company engaged in the installation of sealants for a minimum of two years.
 - 1. Furnish to the Owner the names and addresses of five similar projects which the foregoing people have worked on during the past two years.
 - 2. Furnish a letter from the sealant manufacturer, stating that the foregoing people are authorized to install the manufacturer's sealant materials and that the manufacturer's specifications are applicable to the requirements of this Project.
- F. Manufacturer's Field Advisor: Experienced in the installation of sealants and shall have been regularly employed by the manufacturer of sealants for a minimum of two years.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturers' instructions and recommendations. Protect from damage. Sequence deliveries to avoid delays, but minimize on-site storage.

1.9 PROJECT CONDITIONS

- A. Substrates: Proceed with work only when substrate construction and penetrating work is complete.
- B. Temperature and Humidity: Comply with manufacturer's requirements and recommendations. Joints to be sealed should not be near their fully closed nor fully open extremes.
- C. Conference: Convene a pre-installation conference to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.
 - 1. Advise other trades to ensure that no other work adversely affects sealant bonding surfaces.

1.10 WARRANTY

- A. Provide written warranty signed by manufacturer, agreeing to repair or replace work which exhibits defects in materials or workmanship. "Defects" is defined to include, but is not limited to, leakage of water, abnormal aging or deterioration, and failure to perform as required. Include requirement for removal and replacement of covering and connected adjacent work.
- B. Provide 20 year labor and material warrantee signed by the installer and manufacturer. The warranty will not be contingent on any quality control measures beyond those employed by the contractor and manufacturer at no additional cost. The contractor shall be liable for all temporary rigging, labor, materials and any cost associated with remedying deficient work.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Before installation test each sealant for compatibility with adjacent materials and surfaces and with indicated exposures. Select sealants which are recommended by the manufacturer for each application indicated. Where exposed to pedestrian or vehicular traffic, provide sealants which are non-tracking and are strong enough to withstand the traffic without damage.
- B. Colors: Provide colors as selected by Architect from manufacturer's standard and special colors

- C. Silicone sealants shall be used for all work pertaining to windows and glazing except with architect's written approval.

2.2 SELF-LEVELING POLYURETHANE SEALANT

- A. Provide two or more part, self-leveling, polyurethane based elastomeric sealant, complying with ASTM C920-05 Type M, Grade P, Class 25, having Shore A hardness of not less than 55 when tested according to ASTM D2240-05, cured modulus of elasticity at 100% elongation of not more than 150 psi when tested according to ASTM D412-06a, and tear resistance of not less than 50 lbs./inch when tested according to ASTM D 624-00(2007). Provide one of the following products if they meet or exceed the requirements of these specifications:
 - 1. Pecora Urepan NR-200
 - 2. Tremco TAC 900
 - 3. Tremco 901
 - 4. Sika 1A, SL
- B. Where joint surfaces contain bituminous materials, provide modified sealants which are compatible with bituminous materials encountered.
- C. Extent: Provide self-leveling polyurethane sealant for floor joints not indicated to be sealed with another type of sealant.

2.3 SILICONE RUBBER SEALANT (INTERIOR)

- A. Provide one part, mold and mildew resistant, sanitary interior type silicone rubber based elastomeric sealant, complying with ASTM C 920-05 Type S, Class 25, Grade NS. Provide one of the following products if they meet or exceed the requirements of these specifications:
 - 1. Dow 786
 - 2. General Electric 1702
 - 3. Pecora 863
 - 4. Tremco Proglaze 06
 - 5. Tremco Tremsil 200.
- B. Extent: Provide silicone rubber sealant for all interior joints around toilet room fixtures and control joints in ceramic tile work not on walking surfaces.

2.4 ACRYLIC LATEX SEALANT

- A. Provide permanently flexible, paintable latex rubber modified acrylic emulsion sealant, complying with ASTM C834-05. Provide one of the following products if they meet or exceed the requirements of these specifications:
 - 1. Pecora AC-20
 - 2. Sonneborne Sonolac

3. Tremco TremFlex 834

- B. Extent: Provide acrylic latex sealant for use for exposed acoustical sealant, access doors before painting, and for all interior joints except where silicone rubber sealant is indicated.
- C. At interior joints greater than 1/2 in. in width or subjected to periodic building movement, substitute exterior type sealant specified above.
- D. Where surrounding wall surfaces are to be left unpainted, substitute exterior type sealant as specified above.

2.5 METAL SEAM SEALANT

- A. Provide metal seam sealant, specifically compounded to seal very thin joints in metal to metal joints and to match adjacent metal colors and finishes. Non-silicone sealant may only be used where small joints are not required to adhere to silicone sealant used elsewhere in the system or at perimeter.
- B. Provide one of the following products:
 - 1. Protective Treatments, Inc. PTI 200.
 - 2. Schnee Moorhead Acryl-R
- C. Extent: Provide seam sealant for metal to metal joints in aluminum entrance and storefront, window, and curtain wall systems.

2.6 JOINT FILLERS

- A. Expanded Polyethylene Joint Filler: Flexible, compressible, closed-cell polyethylene of not less than 10 psi compression deflection (25 percent).
- B. Closed Cell Polyurethane Joint Filler: Resilient, compressible, semi-rigid; W.R. Meadows Ceramar or A.C. Horn Closed Cell Plastic Foam Filler, Code 5401

2.7 MISCELLANEOUS MATERIALS

- A. Primer: Provide as recommended by sealant manufacturer for surfaces to be adhered to.
- B. Bond Breaker Tape: Provide polyethylene or other plastic tape as recommended by sealant manufacturer to prevent three-sided adhesion.
- C. Backer Rod: Provide compressible rod of durable nonabsorptive, non-outgassing material as recommended by sealant manufacturer for compatibility with sealant. Provide products of one of the following manufacturers:
 - 1. Backer Rod Manufacturing and Supply Co.
 - 2. Dow Chemical Co.

3. W. R. Meadows, Inc.
 4. Williams Products, Inc.
 5. Woodmont Products, Inc.
- D. Cleaning Solvents: Oil free solvents as recommended by the sealant manufacturer. Do not use re-claimed solvents.
- E. Masking Tape: Removable paper or fiber tape, self-adhesive, non-staining.

PART 3 - EXECUTION

3.1 INSPECTION

- A. The Installer shall examine substrates and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning of sealant work means Installer's acceptance of joint surfaces and conditions.

3.2 PREPARATION & INSTALLATION

- A. Manufacturer's Instructions and Recommendations: Strictly comply with manufacturers' instructions and recommendations, except where more restrictive requirements are specified in this section. Prime all porous surfaces using primer recommended by manufacturer.
- B. Preparation: Clean joint surfaces immediately before installation of sealants, primers, tapes and fillers. Remove all substances which could interfere with bond. Etch or roughen joint surfaces to improve bond. Tape or mask adjoining surfaces to prevent spillage and migration problems. Provide backer rods for all liquid sealants except where specifically recommended against by sealant manufacturers. Prevent three sided adhesion by use of bond breaker tapes or backer rods.
- C. Sealing: Force sealant into joints to provide uniform, dense, continuous ribbons free from gaps and air pockets. Install sealants so that compressed sealants do not protrude from joints. Dry tool sealants to form a smooth dense surface with joint surfaces adhering equally on opposite sides. At horizontal joints form a slight cove to prevent trapping water. Except in hot weather, make sealant surface slightly concave.
1. Sealant Depth and Joint Size: Refer to Drawings for joint sizes. Provide width to depth ratio as follows 1/4" wide:1/4" deep; 1/2" wide:1/2" deep; 1/2"-1" wide: 1/2 x width.
- D. Acoustical Sealing: Seal tightly and completely around all penetrations into (such as outlet boxes) or through walls and floors, at the entire perimeter of walls, and between dissimilar materials.

1. At penetrations through drywall construction, provide a thin sheet metal sleeve approximately 3/4" larger on each side than the penetration. Fit and seal the sleeve tightly to the surrounding drywall on both sides of the wall. Pack the 3/4" space between the sleeve and the penetrating object solidly with fibrous acoustical insulation. Provide resilient, non-hardening acoustical sealant to seal both sides of wall between penetration and sleeve.
2. At penetrations through solid walls and where opening is irregular and greater than 1" larger on each side than the penetration, wrap penetrating object with 1" thick fibrous material and solidly grout space between fibrous material and opening with grout. Pack all voids with fibrous filler and seal both sides with resilient, non-hardening acoustical sealant.
3. Where fire-stopping sealant is used at penetrations through fire-rated assemblies, additional acoustical sealing is not required.

3.3 CURING

- A. Cure sealants in strict compliance with manufacturers' instructions and recommendations to obtain highest quality surface and maximum adhesion. Make every effort to minimize accelerated aging effects and increase in modulus of elasticity.

3.5 FIELD QUALITY CONTROL

- A. Test Samples:
 1. Where directed, for each 1000 linear feet of joint installed, cut out and carefully remove a 6 inch long sample of the undisturbed sealant and joint backer material from the newly installed Work. Remove the samples in the presence of the Owner's Representative who will retain them for evaluating and testing.
 2. Reseal cut out areas with the same materials.

3.4 REPAIR & CLEANING

- A. Remove and replace work which is damaged or deteriorated in any respect.
- B. Clean adjacent surfaces using materials and methods recommended by sealant manufacturer. Remove and replace work that cannot be successfully cleaned.

END OF SECTION

SECTION 07 95 00

EXPANSION CONTROL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. Provide expansion joint cover assemblies and related items to complete the work as indicated on the Drawings and as specified. This Section includes the following:
 - 1. Exterior wall expansion joint cover assemblies and joint fillers.
 - 2. Floor expansion joint cover assemblies.
 - 3. Fire rated expansion joint fillers.

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:
 - 1. Section 03 30 00, Cast-In-Place Concrete.
 - 2. Section 04 20 00, Unit Masonry
 - 3. Section 05 40 00, Cold-Formed Metal Framing
 - 4. Section 06 16 43, Exterior Gypsum Sheathing
 - 5. Section 07 27 16, Sheet Membrane Air Barriers
 - 6. Section 07 46 46, Rain Screen Cladding System
 - 7. Section 07 92 00, Joint Sealants; Sealants and backer-rods.
 - 8. Section 09 65 00, Resilient Flooring

1.4 SUBMITTALS

- A. Product data in form of manufacturer's product specifications, installation instructions, and general recommendations for each type of expansion joint cover assembly indicated.
- B. Material test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of fire-rated expansion joint assemblies with requirements indicated.
- C. Shop drawings showing full extent of expansion joint cover assemblies; include large-scale details indicating profiles of each type of expansion joint cover assembly, splice joints between sections, joinery with other types, special end conditions, anchorages, fasteners, and

relationship to adjoining work and finishes. Include description of materials and finishes.

- D. Samples for each type of metal finish indicated on metal of same thickness and alloy to be used in work. Where normal color and texture variations are to be expected, include 2 or more units in each set of samples showing limits of such variations.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Instructions: In addition to requirements of these specifications, comply with manufacturer's instructions recommendations for all phases of work, including preparation of substrate, applying materials, and protection of installed units.
- B. Single-Source Responsibility: Obtain expansion joint cover assemblies from one source from a single manufacturer.
- C. Fire Performance Characteristics: Where indicated, provide expansion joint cover assemblies identical to those of assemblies whose fire resistance has been determined per ANSI/UL 263, NFPA 251, U.B.C. 43-1, or ASTM E 119-07a and E 814-06 including hose stream test at full-rated period by a nationally recognized testing and inspecting organization or by another means, as acceptable to authorities having jurisdiction.

- 1. Fire Rating: Not less than the rating of adjacent construction.

PART 2 PRODUCTS

2.1 EXPANSION JOINT COVER ASSEMBLIES

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - 1. Architectural Art Mfg. Inc.
 - 2. Balco, Inc.
 - 3. Construction Specialties, Inc.
 - 4. Metalines, Inc.
 - 5. Watson Bowman Acme Corp.

2.2 MATERIALS

- A. Metals:
 - 1. Aluminum: ASTM B 221-06, alloy 6063-T5 for extrusions; ASTM B 209-07, alloy 6061-T6, sheet and plate. Protect aluminum surfaces in contact with cementitious materials with zinc chromate primer or chromate conversion coating.
- B. Nonmetal Products:
 - 1. Extruded Preformed Seals: Single or multilayered rubber extrusions as classified under

ASTM D 2000-08, designed with or without continuous, longitudinal, internal baffles and formed to fit compatible frames, in color indicated, or, if not indicated, as selected by Architect from manufacturer's standard colors.

2. Elastomeric Sealant: Manufacturer's standard elastomeric sealant complying with ASTM C 920-05, Use T, factory-formed and -bonded to metal frames or anchor members; in color indicated, or, if not indicated, as selected by Architect from manufacturer's standard colors.
 - a. Joints Up to 2 in. Wide: Withstand plus or minus 35 percent movement of the joint width without failure.
 - b. Joints 2 in. to 4 in. Wide: Withstand plus or minus 50 percent movement of the joint width without failure.
3. Fire Barriers: Designed for indicated or required dynamic structural movement without material degradation or fatigue. Tested in maximum joint width condition with a field splice as a component of an expansion joint cover in accordance with ANSI/UL 263, NFPA 251, U.B.C. 43-1, or ASTM E 119-07a and E 814-06 including hose stream test at full-rated period by a nationally recognized testing and inspecting organization or by another means, as acceptable to authorities having jurisdiction.

- C. Accessories: Manufacturer's standard anchors, fasteners, set screws, spacers, flexible vapor seals and filler materials, drain tubes, adhesive, and other accessories compatible with material in contact, as indicated or required for complete installations.

2.3 FABRICATION

- A. General: Provide expansion joint cover assemblies of design, basic profile, materials, and operation indicated. Select units comparable to those indicated or required to accommodate joint size, variations in adjacent surfaces, and structural movement. Furnish units in longest practicable lengths to minimize number of end joints. Provide hairline mitered corners where joint changes directions or abuts other materials. Include closure materials and transition pieces, tee-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous joint cover assemblies.
- B. Metal Joint Cover Assemblies: Provide continuous extruded metal frames of profile indicated with seating surface and raised floor rim to accommodate flooring and concealed bolt and steel anchors for embedment in concrete. Provide assemblies formed to receive cover plates of design indicated and to receive filler materials (if any) between raised rim of frame and edge of plate. Furnish depth and configuration to suit type of construction and to produce a continuous flush wearing surface with adjoining finish floor surface.
 1. Floor-to-Floor Joints with Exposed Cover: Provide one frame on each side of joint, designed to support floor plate and filler.
 2. Flat Cover Plates: Provide cover plates of profile and wearing surface indicated. Extend flat plates to lap each side of joint. If required, furnish abrasive-resistant flexible filler for space between edge of cover plate and raised rim of frame.
 - a. Fixed Cover Plates: Attach one side of the cover plate to a frame or finished wearing surface with other side resting on other frame or finished wearing surface in such a manner to allow free movement.

- b. Floating Cover Plates: Secure the cover plate in or on top of frames in such a manner as to have free movement on both sides.
 - 3. Floor Cover Plate Wearing Surfaces: Provide cover plates with plain wearing surface.
 - 4. Provide manufacturer's continuous standard flexible vinyl moisture seals under covers at locations indicated.
 - 5. Floor-to-Wall Joints: Provide one frame on floor side of joint only. Provide wall side frame where required by manufacturer's design.
 - 6. Angle Cover Plates: Attach angle cover plates for floor-to-wall joints to wall with countersunk, flat-head exposed fasteners secured to drilled-in-place anchor shields, unless otherwise indicated, at spacing recommended by joint cover manufacturer.
 - 7. Wall, Ceiling, Roof, and Soffit Joint Cover Assemblies:
 - a. Fixed Metal Cover Plates: Provide on one side of the joint a concealed, continuously anchored frame fastened to wall, ceiling, or soffit only on one side of joint. Extend cover to lap each side of joint and to permit free movement on one side. Attach cover to frame with cover in close contact with adjacent finish surfaces.
 - b. Floating Metal Cover Plates: Secure the cover plate in or on top of frames in such a manner as to have free movement on both sides.
 - c. Flexible Filler: Secure the approved flexible filler between frames in such a manner that it will compress and expand.
- C. Joint Cover Assembly with Preformed Seal: Provide joint cover assemblies consisting of continuously anchored aluminum extrusions and continuous extruded preformed seals of profile indicated or required to suit types of installation conditions shown. Furnish extrusions designed for embedment in concrete and mechanical retention of lugs of field-installed extruded preformed seals. Vulcanize or heat-seal splices (if any) to ensure hermetic joint condition.
 - 1. Include extruded aluminum cover plate with fluted surface; fasten plate to one side of joint and extend plate to lap each side of joint, with free movement and with cover in close contact with adjacent contact surfaces.
- D. Joint Cover Assembly with Elastomeric Sealant: Provide continuous cover joint assemblies consisting of elastomeric sealant factory-bonded to extruded aluminum frames of profile indicated or required to suit types of installation conditions shown. Provide frames for floor joints with means for embedment or anchorage to concrete without use of exposed fasteners and that will result in exposed surfaces of sealant and aluminum frames finishing flush with adjacent finished floor surface without exposing anchors.
- E. Fire Rated Flexible Joint Filler: Provide watertight, tensionless, energy-efficient, 2 hour fire rated joints in vertical-plane walls. Willseal FR-V, Emseal Emshield WFR2 or approved equal.
 - 1. Fire-retardant impregnated foam proven not to vertically delaminate and will fully extend without putting tension on the substrate
 - 2. Pre-coated on the surface with highway-grade, fuel resistant silicone proven not to de-bond or separate if exposed to thermal shock cycling
 - 3. Field-applied epoxy or UL listed adhesive
 - 4. Silicone fillet beads to prove a uniform seal with the substrate.

5. Impregnated foam material must be proven not to take a compression set over time and the FR joint sealant must not rely on "injected sealant bands" along the substrate for its sealing properties.
6. Material shall be capable of movements of -50%, +50% (100% total) of nominal material size.

2.4 METAL FINISHES

- A. General: Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. Apply finishes in factory after products are fabricated. Protect finishes on exposed surfaces with protective covering before shipment.
- B. Aluminum Finishes: Clear Anodized, AA-C22A41; medium matte etched finish with 0.7-mil minimum thick anodic coating.

PART 3 EXECUTION

3.1 PREPARATION

- A. Coordinate and furnish anchorages, setting drawings, templates, and instructions for installation of expansion joint cover assemblies to be embedded in concrete or have recesses formed into edges of concrete slab for later placement and grouting-in of frames.

3.2 INSTALLATION

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing expansion joint cover assemblies to in-place construction, including threaded fasteners with drilled-in expansion shields for masonry and concrete where anchoring members are not embedded in concrete. Provide fasteners of metal, type, and size to suit type of construction indicated and provide for secure attachment of expansion joint cover assemblies.
- B. Cutting, Fitting and Placement: Perform all cutting, drilling, and fitting required for installation of expansion joint covers. Install joint cover assemblies in true alignment and proper relationship to expansion joints and adjoining finished surfaces measured from established lines and levels. Allow adequate free movement for thermal expansion and contraction of metal to avoid buckling. Set floor covers at elevations to be flush with adjacent finished floor materials. Locate wall, ceiling, roof, and soffit covers in continuous contact with adjacent surfaces. Securely attach in place with all required accessories. Locate anchors at interval recommended by manufacturer, but not less than 3 inches from each end and not more than 24 inches on centers.
- C. Joinery and Continuity: Maintain continuity of expansion joint cover assemblies with end joints held to a minimum and metal members aligned mechanically using splice joints. Cut and fit ends to produce joints that will accommodate thermal expansion and contraction of metal to avoid buckling of frames. Adhere flexible filler materials (if any) to frames with

adhesive or pressure-sensitive tape as recommended by manufacturer.

- D. Installation of Extruded Preformed Seals: Install seals to comply with manufacturer's instructions and with minimum number of end joints. For straight sections provide preformed seals in continuous lengths. Vulcanize or heat-seal all field splice joints in preformed seal material to provide watertight joints using manufacturer's recommended procedures. Apply manufacturer's approved epoxy adhesive to both interfaces prior to installing preformed seal. Seal transitions in accordance with manufacturer's instructions.
- E. Installation of Elastomeric Sealant Joint Assemblies: Seal all end joints within continuous runs and joints at transitions in accordance with manufacturer's directions to provide a watertight installation.
- F. Installation of Fire Barriers: Install fire barriers in accordance with federal, state, and local building codes using manufacturer's recommended procedures. Install transition and end joints to provide continuous fire resistance and in accordance with manufacturer's instructions.

3.3 CLEANING AND PROTECTION

- A. Do not remove strippable protective material until finish work in adjacent areas is complete. When protective material is removed, clean exposed metal surfaces to comply with manufacturer's instructions.

END OF SECTION

SECTION 08 11 00

METAL DOORS AND FRAMES

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. Interior standard steel doors and frames, including metal frames for wood doors.
- B. Related Requirements:
 - 1. Section 08 71 00 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings, and finishes.
- B. Shop Drawings: Include the following:

1. Elevations of each door type.
 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 4. Locations of reinforcement and preparations for hardware.
 5. Details of each different wall opening condition.
 6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 7. Details of anchorages, joints, field splices, and connections.
 8. Details of accessories.
 9. Details of moldings, removable stops, and glazing.
- C. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For door inspector.
1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
 2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
- B. Product Test Reports: For each type of fire-rated hollow-metal door and frame assembly for tests performed by a qualified testing agency indicating compliance with performance requirements.

1.7 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- (102-mm-) high wood blocking. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Black Mountain Door, LLC.
 - 2. Ceco Door; ASSA ABLOY.
 - 3. DE LA FONTAINE.
 - 4. DKS Steel Door & Frame Systems, Inc.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
- B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.3 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Standard-Duty Doors and Frames: ANSI/SDI A250.8, Level 1; ANSI/SDI A250.4, Level C. At locations indicated in the Door and Frame Schedule
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Metallic-coated steel sheet, minimum thickness of 0.032 inch (0.8 mm).
 - d. Edge Construction: Model 1, Full Flush.
 - e. Edge Bevel: Provide manufacturer's standard beveled or square edges.

- f. Core: Manufacturer's standard
 - g. Fire-Rated Core: Manufacturer's standard vertical steel stiffener, laminated mineral board core for fire-rated doors.
- 2. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
 - b. Construction: Welded
- 3. Exposed Finish: Prime.

2.4 BORROWED LITES

- A. Fabricate of metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm).
- B. Construction: Face welded.
- C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.
- D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 - 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches (610 mm) of frame height above 7 feet (2.1 m).
 - 3. Postinstalled Expansion Anchor: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than 2-inch (51-mm) height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879/A879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

2.6 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.
- E. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- F. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- G. Glazing: Comply with requirements in Section 088000 "Glazing."

2.7 FABRICATION

- A. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to ANSI/SDI A250.6, the Door Hardware Schedule, and templates.
 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- B. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.
 1. Provide stops and moldings flush with face of door, and with beveled stops unless otherwise indicated.
 2. Provide fixed frame moldings on interior doors and frames.
 3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

4. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

2.8 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.9 LOUVERS

- A. Provide louvers for interior doors, where indicated, which comply with SDI 111, with blades or baffles formed of 0.020-inch- (0.5-mm-) thick, cold-rolled steel sheet set into 0.032-inch- (0.8-mm-) thick steel frame.
 1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
 2. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same qualified testing and inspecting agency that established fire-resistance rating of door assembly.
- B. Form corners of moldings with hairline joints. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with ANSI/SDI A250.11.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 2. Fire-Rated Openings: Install frames according to NFPA 80.
 3. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 4. Solidly pack mineral-fiber insulation inside frames.
 5. Coordinate installation of frames to allow for solidly filling frames with grout.
 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
1. Non-Fire-Rated Steel Doors: Comply with ANSI/SDI A250.8.
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. Glazing: If Applicable, Comply with installation requirements in Section 08 81 00 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

- A. Inspections:
1. Fire-Rated Door Inspections: Inspect each fire-rated door according to NFPA 80, Section 5.2.
 2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements according to NFPA 101, Section 7.2.1.15.

- B. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- C. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- D. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in NFPA 80 and NFPA 101.

3.4 REPAIR

- A. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- B. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08 11 00

SECTION 08 14 00

WOOD DOORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to, the following:
 - 1. Solid core flush wood doors.
 - 2. Glazed and solid panel stile and rail wood doors.
 - 3. Prefitting and premachining of wood doors.
 - 4. Factory finishing of wood doors.

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to:
 - 1. Section 06 40 23, Interior Architectural Woodwork.
 - 2. Section 08 11 00, Metal Doors and Frames
 - 3. Section 08 71 00, Door Hardware
 - 4. Section 08 81 00, Glass Glazing
 - 5. Section 09 91 00, Painting; Field finishing of wood doors.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, specifications, installation instructions, use limitations and recommendations for each door type used. Provide certifications stating that doors comply with requirements.
- B. Shop Drawings: Provide large scale shop drawings for fabrication and installation of all doors. Provide schedules, sizes, elevations, and details of construction, hardware blocking, information on prefabrication and premachining work, and accessory items.
- C. Finishing Specifications: Provide detailed specifications for all factory applied coatings and finishes.
- D. Verification Samples: Submit representative samples of each door and finish that is to be exposed in the finished work, showing the full range of color and finish variations expected. Provide samples having minimum area of 144 square inches.

- E. Test Reports: Submit certified reports for fire-tests.

1.5 QUALITY ASSURANCE

- A. Source: For each type of door required for the work of this section, provide products of one manufacturer to ensure uniformity in quality of appearance and construction.
- B. Architectural Woodwork Institute: Provide doors complying with applicable requirements of *AWI Architectural Woodwork Quality Standards*, Section 1300, for grade, core construction and finish.

1.6 TESTS

- A. Fire-Resistance: Where fire-resistance ratings are indicated or required by authorities having jurisdiction, provide doors which are identical to doors whose fire-resistance rating has been tested in compliance with ASTM E2074 by independent agencies acceptable to the Architect and authorities having jurisdiction.
- B. Provide doors that are labeled and listed by an agency acceptable to authorities having jurisdiction.
- C. When acceptable to authorities having jurisdiction, provide 1-3/4" thick solid core doors without fire-rating labels for "C-Labeled" doors.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver doors in manufacturer's standard package. Store and handle in strict compliance with manufacturer's instructions and recommendations. Comply with the requirements of on-site care recommendations of *WDMA Care and Finishing of Wood Doors*. Protect from damage.
- B. Sequence deliveries to avoid delays, but minimize on-site storage.

1.8 PROJECT CONDITIONS

- A. Weather: Unwrap and install doors only when existing and forecasted weather conditions are within the limits established by manufacturers.
- B. Proceed with work only when wet-work and other potentially damaging construction work is complete.
- C. Ventilation: Comply with manufacturer's requirements and recommendations.

1.9 ON-SITE CONFERENCE

- A. Conference: Convene a pre-installation conference to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

1.10 WARRANTY

- A. Provide written warranty signed by manufacturer agreeing to repair or replace work which exhibits defects in materials or workmanship for the following periods from date of Substantial Completion. "Defects" is defined to include, but is not limited to, warping, bowing, cupping, twisting, telegraphing of core construction, exceeding tolerance limitations of NWMA and AWI, abnormal aging or deterioration, and failure to perform as required.
 - 1. Interior Doors: Life of Installation
- B. Include requirement for refinishing and reinstalling doors repaired or replaced under warranty. Manufacturer or fabricator shall not defer action on any claim; claims shall be satisfied immediately.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements, provide products of one of the following manufacturers or approved equal:
 - 1. Algoma Hardwoods
 - 2. Eggers Industries
 - 3. Marshfield DoorSystems, Inc.
 - 4. VT Industries

2.2 MATERIALS AND PRODUCTS

- A. General: Provide AWI PC-5 construction as specified in AWI Quality Standards Section 1300-S. Core, stiles, and rails shall be glued together before sanding. Wood for stiles and rails shall be thoroughly seasoned, kiln-dried stock with 5% to 8% moisture content.
- B. Provide same exposed surface on both sides of door, unless indicated otherwise.
- C. Cut and trim openings (if shown), comply with applicable requirements of referenced standards.
- D. All factory-finished doors shall be shipped in individual protective packaging to jobsite.

2.3 DOORS AND COMPONENTS

- A. Solid Core Doors:
 - 1. Core for non-fire-rated doors shall be 28 to 32 lb./cu. ft., Grade 1-L-1 particleboard conforming to ANSI A208.1, consisting of wood particles bonded together with synthetic resins, except as specified otherwise.
 - 2. Core for fire-rated doors shall be manufacturer's standard mineral core conforming to

ANSI A208.1, Algoma Weldrok core, or approved equal.

3. Core for stave core doors shall be lumber staves, edge glued, kiln-dried softwood lumber of single species, with horizontal joints staggered in contiguous rows.
4. Crossbands shall be 1/16 in. thick hardwood, full width of door, with grain at right angle to face veneer grain.
5. Blocking: Provide blocking with screw holding capability for doors to receive surface mounted hardware.
6. Veneers for transparent finishes shall be vertical book-matched as specified in Section 06402, flat sliced, at least 1/50 in. thick, adhered to 1/16 in. hardwood crossband, core, rails, and stiles by hot press method.
7. Veneers for painted finish shall be at least 1/50 in. thick medium density overlay phenolic resin impregnated cellulose fiber sheet, bonded to 1/16 in. hardwood crossband backing, and adhered to core, rail and stile by hot-press method, suitable for painted finish as specified in Section 09 91 00, PAINTING.
8. Glass for glazed wood doors shall be tempered, minimum 1/4 in. thick and shall comply with Section 08 81 00, GLASS AND GLAZING.

- B. Solid Core Doors - Fire-Rated: Provide faces, grade, and quality to match non-rated doors, unless otherwise indicated. Provide manufacturer's standard core construction to obtain fire-resistance rating indicated or required. Provide laminated edge construction for improved screw-holding resistance and split resistance.
- C. Stile and Rail Doors: AWI Premium Grade, veneered laminated-strand lumber core with face and edges of maple specified. Glass panels shall be laminated glass as specified in Section 08 81 00, Glass and Glazing.
- D. Glazing: Provide loose glazing stops as required for use under Section 08 81 00, Glass and Glazing.

2.4 PREFITTING AND PREMACHINING

- A. At factory, prefit doors to frames and premachine doors for hardware listed on final schedules.
- B. Comply with tolerance requirements of AWI for non-rated doors and NFPA for fire-rated doors.
- C. Bevel non-rated doors 1/8" in 2" at lock and hinge stiles. Bevel rated doors 1/8" in 2" at lock edge only.

2.5 FINISHES

- A. Interior Doors for Painted Finish: Field finish as specified in Section 09 91 00, PAINTING.
- B. General: Comply with referenced quality standard's requirements for factory finishing.
 1. Quality Standard: Provide AWI Premium Grade for finishing, complying with AWI Quality Standards, Section 1500.

2. Preparation for Finishing: Comply with AWI Quality Standards for sanding, filling, countersinking, sealing of concealed surfaces, and similar preparation requirements for finishing of work of this Section.
- C. Transparent Finish: Match finish as specified in Section 06 40 23, Interior Architectural Woodwork.

PART 3 - EXECUTION

3.1 INSPECTION

- A. The Installer shall examine frames and conditions under which this work is to be installed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means Installer accepts substrates and conditions.

3.2 PREPARATION

- A. Strictly comply with manufacturers' instructions and recommendations, except where more restrictive requirements are specified in this section.
- B. Condition doors to prevailing conditions before installing.

3.3 INSTALLATION

- A. Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section.
- B. Prefit and premachine doors to the extent not done at factory. Restore factory finishes before installing.
- C. For non-rated doors, provide 1/8" clearances at head, jambs and meeting stiles (of pairs of doors). Provide 1/2" clearance at bottom and as required to clear flooring, except at thresholds provide 1/4" clearance. Coordinate with gasketing requirements.
- D. For fire-rated doors, provide clearances complying with NFPA 80.

3.4 ADJUSTING, CLEANING, PROTECTION

- A. Adjust doors to work easily, smoothly, and correctly.
- B. Touch-up damaged coatings and finishes to eliminate evidence of repair.
- C. Repair minor damage to eliminate all evidence of repair. Remove and replace work which cannot be satisfactorily repaired.
- D. Clean exposed surfaces using materials and methods recommended by manufacturer of material or product being cleaned. Remove and replace work that cannot be successfully

cleaned.

- E. Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protections and reclean as necessary immediately before final acceptance.

END OF SECTION

SECTION 08 31 00

ACCESS DOORS AND PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to, the following:
 - 1. Access doors in walls and ceilings to provide access to chases, valves, controls and equipment.

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to:
 - 1. Section 07 92 00, Joint Sealers
 - 2. Section 09 21 16, Gypsum Board Assemblies
 - 3. Section 09 91 00, Painting
 - 4. Division 22, Plumbing
 - 5. Division 23, HVAC
 - 5. Division 26, Electrical

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations for each material used. Provide certifications stating that materials comply with requirements.

1.5 INTENT

- A. A major intent of the work of this section is to provide access to every chase, valve, control and item of equipment that would otherwise be inaccessible, and to eliminate requirements for accessibility to the drywall areas of new ceiling work.

1.6 QUALITY ASSURANCE

- A. Source: For each type of material required for the work of this section, provide primary materials which are the products of one manufacturer. Provide secondary materials which are acceptable to the manufacturers of the primary materials.

- B. Sizes: Provide access doors of appropriate size for their intended use. Use manufacturer's standard sizes wherever possible.

1.7 TESTS

- A. Fire-Resistance: Where fire-resistance ratings are indicated or required by authorities having jurisdiction, provide access doors which are identical to assemblies whose fire-resistance rating has been tested by independent agencies acceptable to the Architect and authorities having jurisdiction. Provide UL labeled assemblies.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage. Sequence deliveries to avoid delays, but minimize on-site storage.

1.9 COORDINATION

- A. Conference: Convene a pre-installation conference to establish procedures to coordinate this work with related and adjacent work.
- B. Coordination: Furnish inserts and anchors which must be built into other work. Work closely with installers of finish materials, so that access doors are aligned and installed flush with adjacent finishes.
 - 1. Exact location of access doors shall be approved by Architect prior to installation of work requiring access.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Provide products of one of the following manufacturers if they meet or exceed the requirements of these specifications:
 - 1. Karp Associates, Inc.
 - 2. Meadowcraft, Inc.
 - 3. Milcor/Inryco
 - 4. Nystrom, Inc.

2.2 MATERIALS AND PRODUCTS

- A. Provide each access door assembly manufactured as a complete unit, ready for installation with all necessary parts.

- B. Provide access doors that are full welded with welds ground flush and smooth and fabricated from sheet steel as follows:
 - 1. Frames: Minimum 16 gage galvanized steel, with no exposed frame.
 - 2. Flush Doors: Minimum 14 gage galvanized sheet steel with concealed continuous piano hinge set to open 175 degrees or concealed spring hinges on fire-rated doors.
 - 3. Recessed Doors: Minimum 14 gage galvanized sheet steel designed with a 5/8" depth pan to receive a layer of drywall for a concealed appearance and concealed continuous piano hinge set to open 175 degrees or concealed spring hinges on fire-rated doors.
 - 4. Where installed at fire-rated walls or ceilings access panels shall be of fire-resistive construction and shall bear the U.L. 2-hr. label.
 - 5. Where installed in surfaces finished with ceramic tile or glazed coatings, access panels shall be ASTM A 666, Type 304 stainless steel with No. 4 finish.
 - 6. Locks/Latches: Provide at least two screwdriver operated cam latches for each door to hold door in flush, smooth plane when closed. On fire-rated assemblies, provide manufacturer's standard self-latching, fire-rated devices. In public areas, such as toilet rooms, provide keyed cylinder locks with all doors keyed the same. Provide two keys for each locked access door.

2.3 FINISHES

- A. Factory Primed: Provide minimum 2. mil dry film thickness of rust-inhibiting primer which is compatible with finish paint specified in Painting Section.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section. Beginning work means Installer accepts substrates and conditions.
- B. Coordinate installation with related and adjacent work. Set frames accurately into position and securely fasten truly plumb and level and in proper alignment with adjacent finishes. Set doors so that frames are in full contact with surrounding construction on entire perimeter.

3.2 ADJUSTING, CLEANING, & PROTECTION

- A. Adjust operating parts to work easily, smoothly, and correctly.
- B. Touch-up damaged coatings and finishes to eliminate evidence of repair.

- C. Repair minor damage to eliminate all evidence of repair. Remove and replace work which cannot be satisfactorily repaired.
- D. Clean exposed surfaces using materials and methods recommended by manufacturer of material or product being cleaned. Remove and replace work that cannot be successfully cleaned.

END OF SECTION

SECTION 08 35 13

INTERIOR GLASS WALL/DOOR SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to, the following:
 - 1. Aluminum framed sliding/folding glass wall systems, including frame, threshold, door panels, sliding/folding/swing and locking hardware, weather stripping, glass and glazing; with sizes and configurations as shown on drawings.

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to:
 - 1. Section 05 50 00 - Metal Fabrications
 - 2. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section
 - 3. Section 08 81 00 - Glazing: Glass and glazing accessories

1.4 SUBMITTALS

- A. Product Data: Manufacturer's literature including independently tested data listing performance criteria and Owner's Manual with installation instructions.
- B. Shop Drawings: Indicate dimensioning, direction of swing, configuration, swing panels, typical head jamb, side jambs and sill details, type of glazing material, and handle height.
- C. Hardware Schedule: Complete itemization of each item of hardware to be provided for each panel, cross-referenced to panel identification numbers in Contract Documents.
- D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing aluminum framed bi-folding glass wall systems with a minimum three years of documented experience. Single source manufacturer..

- B. Installer Qualifications: Installer experienced in the installation of manufacturer's products or other similar products for large openings. Installer to provide reference list of at least 3 projects of similar scale and complexity successfully completed in the last 3 years.
- C. Performance Requirements: Provide from manufacturer that has independently tested typical units.

1.6 WARRANTY

- A. Provide manufacturer's warranty against defects in materials and workmanship. Warranty Period: Three years from date of substantial completion.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage. Sequence deliveries to avoid delays, but minimize on-site storage.

1.8 COORDINATION

- A. Conference: Convene a pre-installation conference to establish procedures to coordinate this work with related and adjacent work.
- B. Coordination: Furnish inserts and anchors which must be built into other work. Work closely with installers of finish materials, so that doors are aligned and installed flush with adjacent finishes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of design: Design is based on products manufactured by U.S. Aluminum, a C.R. Laurence Company (CRL).
 - 1. Bi-folding stacking operable wall: The Monterey S55 Series
 - 2. Bi-parting sliding pocket door/operable wall: Series 2000
 - 3. Fixed lite glazing panels: Series 487-AR

2.2 MATERIALS AND PRODUCTS

- A. Frame and Panels: From manufacturer's standard profiles, provide head track, side jambs, and panels with dimensions shown on drawings.
 - 1. Provide panels with: Standard one lite as shown on drawings].
 - 2. Provide standard bottom rail.
 - 3. Aluminum Extrusion: Extrusions with nominal thickness of .078" minimum. Anodized

conforming to AAMA 611 or powder coated conforming to AAMA 2604.

4. Aluminum Finish: satin clear anodized.

B. Glass:

1. All glass to comply with safety glazing requirements of ANSI Z97.1 and CPSC 16CFR 1201. Provide manufacturer's standard glass with dry glazing with glass stops on the inside only: 1/4 inch (6 mm) clear monolithic tempered

C. Locking Hardware and Handles:

1. Manufacturer's standard three point lock with lever handles on the inside and outside with keyed cylinder outside and thumb turn inside.]

D. Sliding/Folding Hardware: Provide manufacturer's standard combination sliding and folding hardware with top and bottom tracks and threshold.

E. Adjustment: Provide system capable of adjustments without removing panels from tracks.

F. Other Components:

1. Weather stripping: Provide manufacturer's standard non-broken EPDM seals between panels, and between panel and frame.

2.3 FABRICATION

- A. Use extruded aluminum frame and panel profiles with hinges, sliding, and folding hardware, locking hardware and handles, glass and glazing and weather stripping as specified herein to make a folding glass wall. Factory pre-assemble as is standard for manufacturer and ship with all components and installation instructions.

- B. Sizes and Configurations: See drawings for selected custom dimensions. See drawings for selected number of panels and configuration. Provide each assembly manufactured as a complete unit, ready for installation with all necessary parts.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section. Beginning work means Installer accepts substrates and conditions.
- B. Coordinate installation with related and adjacent work. Set frames accurately into position and securely fasten truly plumb and level and in proper alignment with adjacent finishes. Set doors so that frames are in full contact with surrounding construction on entire perimeter.
- C. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

- D. Provide alignment attachments and shims to permanently fasten system to building structure.
- E. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
 - 1. Maximum Variation from Plumb: 0.06 inches every 3 ft (1.5 mm/m) non-cumulative or 1/16 inches per 10 ft (1.5 mm/3 m), whichever is less.
 - 2. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).
- F. Install glass and infill panels in accordance with Section 08 8100, using glazing method required to achieve performance criteria.
- G. Install perimeter sealant in accordance with Section 07 92 00.

3.2 ADJUSTING, CLEANING, & PROTECTION

- A. Adjust operating parts to work easily, smoothly, and correctly.
- B. Touch-up damaged coatings and finishes to eliminate evidence of repair.
- C. Repair minor damage to eliminate all evidence of repair. Remove and replace work which cannot be satisfactorily repaired.
- D. Clean exposed surfaces using materials and methods recommended by manufacturer of material or product being cleaned. Remove and replace work that cannot be successfully cleaned.

END OF SECTION

SECTION 08 51 00

ALUMINUM WINDOWS AND DOORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this section.

1.2 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to, the following:
 - 1. Aluminum windows, fixed and dual-swing type.
 - 2. Aluminum doors within exterior framing system.
 - 3. Aluminum trim, closures, corner caps and glazed infill panels to complete assemblies.

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:
 - 1. Section 04 20 00 Unit Masonry
 - 2. Section 05 40 00 Cold-Formed Metal Framing
 - 3. Section 06 10 00 Rough Carpentry
 - 4. Section 07 27 16 Sheet Membrane Air Barriers
 - 5. Section 07 92 00 Joint Sealants
 - 6. Section 08 81 00 Glass and Glazing

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's printed product data, specifications, standard details, installation instructions, use limitations and recommendations for each material used. Provide certifications that windows comply with specified requirements. Product data for each type of window required, shall include:
 - 1. Construction details and fabrication methods.
 - 2. Profiles and dimensions of individual components.
 - 3. Data on hardware, accessories, and finishes.
 - 4. Recommendations for maintenance and cleaning of exterior surfaces.
- B. Shop Drawings: Provide large scale shop drawings for fabrication, installation and erection of all parts of the work. Provide plans, elevations, and details of anchorages, connections and

accessory items. Provide installation templates for work installed by others. Show all interfaces and relationships to work of other trades. Include information not fully detailed in manufacturer's standard product data and the following:

1. Layout and installation details, including anchors.
 2. Elevations of continuous work at 1/4 inch scale and typical window unit elevations at 3/4 inch scale.
 3. Full-size section details of typical composite members, including reinforcement.
 4. Glazing details.
 5. Accessories.
- C. Certification: Provide certification by a recognized independent testing laboratory or agency showing that each type, grade, and size of window unit complies with performance requirements indicated.
- D. Initial Selection Samples: Submit samples showing complete range of colors, textures, and finishes available for each material used.
- E. Verification Samples: Submit representative samples of each material that is to be exposed in the completed work. Show full color ranges and finish variations expected. Provide samples having minimum size of 144 sq. in.

1.5 QUALITY ASSURANCE

- A. Source: For each material type required for the work of this section, provide primary materials which are the product of one manufacturer. Provide secondary or accessory materials which are acceptable to the manufacturers of the primary materials.
- B. Installer: A firm with a minimum of five years experience in type of work required by this section and which is acceptable to the manufacturers of the primary materials.
- C. Design Requirements: Comply with structural performance, air infiltration, and water penetration requirements indicated in AAMA GS-001 for type, grade, and performance class of window units required.
- D. Indications of section sizes and reinforcement on the Drawings are for design intent only. Manufacturer shall provide proper structural design and anchorage.
- E. Mock-Up: Mock-up of exterior wall is required. Comply with requirements of Section 01 43 39, Mock-Ups.

1.6 TESTS AND PERFORMANCE REQUIREMENTS

- A. Manufacturer's Standard Tests: Provide manufacturer's standard test data showing compliance with specified requirements.
- B. Test products to AAMA/WDMA/CSA 101/I.S.2/A440-17 North American Fenestration

Standard. Performance to meet or exceed AW-PG70-DAW Dual Action Tilt/Turn and Fixed Windows.

- C. Test Sequence: Test sequence is optional, except that air infiltration tests shall precede water resistance tests.
- D. Air Infiltration Test: With window sash and ventilators closed and locked, test unit in accordance with ASTM E 283, as follows:
 - 1. Static Air Pressure Difference: 5% of specified Design Wind Pressure, but never less than 6.24 pounds per square foot.
 - 2. Air Infiltration: Air infiltration shall not exceed 0.04 cfm/sq.ft. when tested in accordance with ASTM E 283.
- E. Water Leakage Test: Test unit in accordance with ASTM E 547, with four test cycles, each cycle consisting of five minutes with pressure applied, and one minute of pressure released, during which time the water spray will be continuously applied.
 - 1. Test Pressure: 20% of specified Design Wind Load, but never less than 15 pounds per square foot.
 - 2. Performance: No leakage as defined in the test method at the specified test pressure.
 - 3. Water Infiltration: Window shall allow no water penetration when tested in accordance with ASTM E 331.
- F. Uniform Load Deflection Test: Test units in accordance with ASTM E 330, at the following static air pressure difference (70 psf positive and negative Design Wind Pressure), or the loads prescribed by code for this project site, whichever is greater. Apply pressure first to the exterior side (positive) and then the interior side (negative).
 - 1. Test Procedure: Procedure A at 150% of Design Wind Pressure as specified in ASTM E 330.
 - 2. Performance: Deflection in each member measured at locations of greatest deflection shall not exceed L/175 of member span at the specified Design Wind Pressure.
 - 3. All intermediates, vertical, and horizontal members, including meeting rails must handle Design Wind Pressure at L/175 deflection with no change in sightline or system depth to that which is detailed.
- F. Uniform Load Structural Test: Test units in accordance with ASTM E 330, at the following static air pressure difference (70 psf positive and negative Design Wind Pressure), or the loads prescribed by code for this project site, whichever is greater. Apply pressure first to the exterior side (positive) and then the interior side (negative).
 - 1. Test Procedure: Procedure A at 150% of Design Wind Pressure as specified in ASTM E 330.
 - 2. Performance: No failure or permanent deformation.
- G. Condensation Resistant Factor: Per AAMA 1503.1, value not less than 55.

- H. Thermal Movement: Provide window systems that allow for expansion and contraction of members throughout an ambient temperature range of 120°F.
- I. Thermal Transmittance:
 - 1. Provide window units that have a U-value maximum 0.15 rated in BTU/hour/sq. ft./degrees F at 15-mph exterior wind velocity, when tested in accordance with AAMA 1503.1. Test unit to be 4 ft. x 6 ft.
 - 2. Provide window units that have a maximum solar heat gain coefficient (SHGC) of 0.38.
- J. Field Leakage Test: The Owner reserves the right to employ an independent testing agency to perform in-place field tests for water leakage. Complete on-site window mock-up and surrounding wall construction at earliest possible date in order that any problems or failures can be identified before majority of windows have been installed. Field test will include a prolonged water spray test. Any uncontrolled water leakage will be considered a failure. Contractor shall pay for all remedial work and all retesting due to failures.

1.7 PROJECT CONDITIONS

- A. Weather: Perform work of this Section only when existing or forecasted weather conditions are within the limits established by manufacturers of the materials and products used.
- B. Substrates: Proceed with work only when substrate construction and penetration work is complete.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials and products in unopened, factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Store under cover and protect from weather damage.
- B. Sequence deliveries to avoid delays, but minimize on-site storage.

1.9 WARRANTIES

- A. Aluminum Windows and Related Materials: Provide a written warranty, signed by the manufacturer agreeing to repair or replace work which exhibits defects in materials or workmanship, including all extrusions, weatherstripping, panning, and trim, and all hardware. Defects" is defined to include, but not limited to, leakage of water, abnormal aging or deterioration, abnormal deterioration or fading of finishes, and failure to perform as required. Include requirement for removal and replacement of windows and connected adjacent work.
 - 1. Windows: Manufacturer shall warrant for five years against defects in material and workmanship under normal use.
 - 2. Insulating Glass Units: Glass manufacturer shall warrant seal for ten years against visual obstruction from film formation or moisture collection between internal glass surfaces, excluding that caused by glass breakage or abuse.

3. Powder Paint Finish: Finish conforming to AAMA 2605 shall be warranted for twenty years against checking, cracking, chalking, or fading.

PART 2 PRODUCTS

2.1 WINDOW AND DOOR SYSTEMS

- A. Basis-of-Design Product: YKK YOW 350 XT window system and YKK AP Series 35XT Medium Stile Entrance Doors.

2.2 MATERIALS AND PRODUCTS

- A. Aluminum Extrusions: Alloy and temper recommended by aluminum window manufacturer for strength, corrosion resistance, and application of required.
- B. Thermal Barrier: The thermal barrier shall consist of integral structural thermal break made with glass-reinforced nylon strips installed continuously and mechanically bonded to the aluminum.
- C. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum window members, trim, hardware, anchors, and other components.
- D. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
- E. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC3 severe service conditions; provide sufficient strength to withstand design pressure indicated.
- F. Sealant: For sealants required within fabricated windows, provide window manufacturer's standard, permanently elastic, non-shrinking, and nonmigrating type recommended by sealant manufacturer for joint size and movement.

2.3 GLAZING

- A. Glass shall be as indicated on schedules on Drawings and in accordance with requirements of Section 08 81 00.
- B. Factory glaze windows and doors.

2.4 FABRICATION

- A. Fabricate windows and doors to be truly straight, plumb, level and square, within tolerances permitted by reference standards.

- B. Fabricate work to sizes, shapes, and profiles indicated on Contract Documents and approved shop drawings.
- C. Fabricate work with uniform, tight hairline joints, free from sharp edges.
- D. Provide manufacturer's structural thermal break made with glass reinforced nylon strips installed continuously and mechanically bonded to the aluminum frame. Comply with AAMA TIR A8. Fabricate frames to prevent water from coming in contact with sealed edges of insulating glass.
- E. Windows shall be re-glazable without dismantling sash or framing.

2.5 HARDWARE

- A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows, and sized to accommodate sash weight and dimensions.
- B. Dual Action Window Typical Hardware:
 - 1. Concealed Handle: Handle to be concealed within the sash stile; First motion turn inward, second motion tilt inward.
 - 2. Handle Finish: Painted to match interior window color.
 - 3. Hinges: Concealed Stainless Steel Hinges..
- C. Swing Door Typical Hardware:
 - 1. Hinges
 - 2. Mortise Lockset (exit only) with interior egress trim, no trim at exterior.
 - 3. Closer
 - 4. Door Stop
 - 5. Threshold
 - 6. Weather Seals
 - 7. Position Switch (Supplied by Security Vendor)
 - 8. Cylinder - compatible with building standard.

2.6 INFILL PANELS

- A. Aluminum faced insulated rigid mineral fiber core infill panels. Faces to be .050 aluminum, smooth surface, finish color as selected by Architect. Panels to be glazed into window frame.

2.6 CLOSURES AND TRIM

- A. Provide aluminum trim at perimeter of window assemblies to provide closures and transition to adjacent materials. Match profiles shown on Drawings and approved shop drawings. Where possible, utilize extruded materials in required profiles. Provide custom brake formed materials where standard extrusion profiles are not available. Faces to be .050 aluminum,

smooth surface, finish color as selected by Architect. Edges shall be returned and provide sufficient surface for sealants.

- B. Corner caps: Provide brake metal corner caps to profiles shown on the drawings. Return all edges into joints to depth of sheathing. Fully adhere corner caps to sheathing substrate. Fabricate without visible oil canning, buckling, tool marks or other defects. Set true to line with no exposed fasteners.

2.7 FINISH

- A. Finish: AAMA 2605, Coating: Superior Performance Powder coating: One-coat dry system with resin containing 70% fluoropolymer; thermosetting;
 - 1. Color as indicated on finish schedule and to match Architect's sample.

PART 3 EXECUTION

3.1 INSPECTION

- A. The Installer/Erector shall examine substrates, supports, and conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning of installation will be construed as installer accepting substrates and conditions.

3.2 INSTALLATION

- A. General Installation Requirements: Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section.
- B. Installation: Install window units plumb, level, in alignment and plane without warp or rack. Anchor securely in place. Install trim and closure materials, including corner cap panels at outside building corners, to provide complete assemblies and transition to adjacent materials.
- C. Dissimilar Materials: Isolate all dissimilar metals. Comply with ANSI/AAMA 101, Appendix.
- D. Sealants: Install sills and subframes in a thick bed of sealant. Comply with applicable requirements of Section 07 92 00, Joint Sealers.
- E. Flashing: Coordinate with flashing installation to ensure weathertight construction and assembly. Thoroughly seal all penetrations through flashings with thick bed of sealant. Comply with applicable requirements of Section 07 60 00, Flashing and Sheet Metal.
- F. Air barriers: Coordinate with air barrier installation to ensure proper termination for continuous barrier.

3.3 TOLERANCES

- A. The following allowable installed tolerances are allowable variations from locations and dimensions indicated by the Contract Documents. Do not add these tolerances to any allowable tolerances indicated for other work.

- 1. Allowable Variation from True Plumb, Line and Level: $\pm 1/8$ in. in 20 ft.-0 in.

3.4 ADJUSTING, CLEANING, TOUCH-UP, AND PROTECTION

- A. Clean exposed surfaces using manufacturer recommended materials and methods. Remove and replace work which cannot be successfully cleaned.
- B. Touch-up damaged coatings and finishes. Eliminate all visible evidence of repair.
- C. Provide temporary protection at all times during the course of the work, and immediately after completion to ensure the work of this Section is not damaged or deteriorated in any way at time of final acceptance. Remove temporary protections and reclean as necessary immediately prior to final acceptance.

END OF SECTION

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Work of this Section, as shown or specified, shall be in accordance with the Contract Documents.

1.2 WORK INCLUDED

- A. Work of this Section includes all labor, materials, equipment and services necessary to furnish all the finish hardware as shown on the drawings and specified herein.

1.3 RELATED WORK

- A. Finish Carpentry - Section 06 20 00
- B. Wood Doors - Section 08 14 00

1.4 QUALITY ASSURANCE

- A. Hardware shall be suitable and adapted for its required use and shall fit its designated location. Should any hardware as shown, specified or required fail to meet the intended requirements or require modification to suit or fit the designated location, determine the correction or modification necessary and notify the Architect in ample time to avoid delay in the manufacture and delivery of hardware.
- B. For fire rated openings provide hardware complying with NFPA Standard No. 80 requirements of authorities having jurisdiction.
- C. Barrier Free Requirements: Local laws complying with the American Disabilities Act shall apply.
- D. Hardware Supplier Qualifications: The Hardware Supplier shall have been regularly engaged in the sale and distribution of Finish Hardware for projects of comparable scope and size for a minimum of five (5) years. The Hardware Supplier shall have an AHC of the Door and Hardware Institute on staff who will be responsible for overseeing the scheduling, detailing, ordering, and coordinating of Finish Hardware, and shall be available for consultation with the Architect, at no additional cost to the Owner, during progress of construction. The Hardware Supplier shall be a direct factory authorized distributor for all Finish Hardware items being furnished in accordance with this Specification.

1.5 SUBMITTALS

- A. Before any finish hardware is ordered or purchased, submit catalog cuts and a complete Hardware Schedule of Finish Hardware. Each item listed in the Hardware Schedule shall be identifiable with respect to manufacture, brand, catalog number, material, and finish.
 - 1. Schedule of Finish Hardware shall be submitted in the Vertical Schedule Format per Door and Hardware Institute Sequence & Format for the Hardware Schedule (1996).
- B. Where submission differs from Schedule given herein, use different color or other means of identification to bring change to the attention of the Architect.
- C. Hardware Supplier shall provide all product information, wiring diagrams, and electrical data to the Electrical Contractor.
- D. Samples: Submit samples as requested by Architect. Do not proceed with installation until samples have been approved. Approved samples may be installed in the work after substantial completion of work. Samples shall include one (1) each of the following samples:
 - 1. Hinge (Each Type)
 - 2. Intermediate Pivot
 - 3. Surface Closer
 - 4. Lockset (Entrance Function)
 - 5. Floor Stop
 - 6. Push-Pull Plates
 - 7. Push-Pull Bars
 - 8. Finish Sample of all other hardware, as requested by the Architect.

1.6 PRODUCT HANDLING

- A. Pack finish hardware in approved manufacturer's containers, complete with trimmings, bolts, screws, washers, etc., as required for application and securement. Each container shall bear a suitable label which will state the quantity and kind of contents of said container, as well as identifying marks relating to the approved Hardware Schedule and its location in the project.
- B. Levers, handles, pulls and any other items of finish hardware with easily damaged finishes shall be individually wrapped before placing in containers and with sufficient sheet cloth or cotton-backed paper which shall be adequately tied with heavy strings; all as necessary to protect the finishes.
- C. Finish hardware shall be delivered, as directed, to the building site or the factories of the various fabricators of metal work to which such hardware is to be applied. Deliver hardware in the order required and in ample time to permit application at the building, or fabricators' shops, within the time required for the completion of the building.

1.7 JOB CONDITIONS

- A. Field Service: The hardware supplier shall assign a competent representative, acceptable to the Architect, to be at the jobsite each time a major shipment of finish hardware is received. Such

representative shall assist in "checking in" these shipments and shall secure a receipt covering the contents of each shipment. In addition, such representative shall be available for immediate call to the jobsite when, in the opinion of the Architect, their presence is necessary.

- B. Templates: Promptly following approval of the Hardware Schedule by the Architect, furnish and deliver template information, to the fabricators, of items to which finish hardware is to be applied.
 - 1. Such deliveries shall be made in ample time to avoid delays in such work of said fabricators. Provide drawings, schedules and detailed information to other trades as necessary for them to accommodate and prepare their work to receive the finish hardware.
- C. Cooperation and Coordination
 - 1. Cooperate and coordinate work with that of other trades supplying materials or performing work in contact with, connecting to, underlying, or overlaying the work of this Section.
 - 2. Provide complete data of requirements for work of this Section to those other trades whose work is affected by or dependent upon the work of this Section.
 - 3. Furnish all items to be built into other work in ample time to avoid delaying the progress of such work.
 - 4. Examine all drawings covering the work of this Section and refer to all other drawings, including mechanical and electrical drawings, which may affect the work of this Section or require coordination by this trade.
- D. Existing Conditions: Hardware Supplier shall verify all existing conditions in the field to ensure compatibility with hardware specified in the Hardware Sets herein. Any discrepancies between the existing field conditions and hardware specified shall be brought to the attention of the Architect immediately. Hardware Supplier shall not order any hardware until all discrepancies are rectified and written approval is granted by the Architect.

1.8 WARRANTY

- A. Provide a letter from the manufacturer of surface mounted closers, warranting such closers for five (5) years.
- B. Provide a letter from manufacturer of concealed floor closers, warranting such closers for twenty-five (25) years.
- C. The hardware supplier shall provide a written one (1) year warranty for the rest of the items furnished under this Section.
- D. All warranties shall be effective beginning with the date of Beneficial Occupancy.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Requirements for design, grade, function, finish, size and other distinctive qualities of each type of finish hardware are indicated herein. Products are identified by using appropriate hardware designation numbers.
- B. Manufacturers are listed for each hardware type required. Provide either the product designated, or approved equal.
- C. Proprietary Products: References to specific proprietary products are used to establish minimum standards of utility and quality. Other materials may be considered by the Architect in accordance with the provisions stated in Division 1 of these specifications.
- D. Notwithstanding anything to the contrary in this specification or the drawings, the finish hardware shall conform to the requirements of governmental authorities having jurisdiction and such requirements shall be followed as if specifically set forth in this specification.
- E. Finish hardware shall conform to the applicable requirements of the American Insurance Association, and the National Board of Fire Underwriters' Laboratories, Inc., and other local authorities having jurisdiction, and each such item shall bear a label or mark of the Underwriters' Laboratories, Inc., indicating its conformity with such requirements for use in connection with its specified location.
- F. Finish hardware shall be uniform in color and finish and free from imperfections affecting its appearance, function, operation and serviceability. Such hardware shall be suited and adapted to its required use and shall fit its respective location.
- G. Where the finished shape or size of members receiving finish hardware are such as to prevent or render unsuitable the use of the specific types or sizes of such hardware, suitable types or sizes shall be furnished, having as nearly as practicable the same function, operation and quality as the specified hardware.
- H. Bolts, screws and other fastenings required for the application of the finished hardware shall be of size and type to fit requirements and shall be of the same material and finish as the exposed parts of such hardware which they adjoin. Exposed screws and bolts shall have countersunk oval heads and bolts shall be provided with cap nuts. Countersunk part of screw and bolt holes shall be finished smoothly without sharp edges and form a firm seal for such screw and bolt heads. Full threaded wood screws shall be furnished for all wood applications. No thru bolts will be allowed. Sex-nuts and bolts shall be provided on push/pulls, exit devices, closers, etc. when being attached to mineral core or particle core wood fire doors.

2.2 PRODUCTS AND MANUFACTURERS

- A. The following are acceptable manufacturers, unless specifically indicated in the Hardware Sets. Underlined manufacturers are those whose products are indicated in the hardware sets.
- B. Substitution requests must be made in accordance with Division 1 of these Specifications.

HINGES & SPRING HINGES: Ives
FLUSH BOLTS & DUSTPROOF STRIKES: Ives
PUSH/PULLS: Ives
LOCKSETS & LATCHSETS: Salto.
CYLINDERS & KEYING: Salto
EXIT DEVICES: Von Duprin
CLOSERS: LCN
PROTECTION PLATES: Ives
STOPS: Ives
SILENCERS: Ives
SADDLES & GASKETING: Zero.

2.3 SPECIFIC ITEMS

A. Hinges

1. Minimum of three (3) hinges per door leaf up to 7'-6" high. Provide one additional hinge per 2'-6" or fraction thereof.
2. Hinges shall be of types, sizes and materials as required to suit door weights thickness and fire ratings.
3. Unless otherwise specified hinges shall be standard weight. Doors 3'-4" in width shall receive 5 x 4½ .146 gauge hinges. Doors over 3'-4" in width shall receive 5 x 4½ .190 gauge hinges.
4. Hinge sizes shall be detailed so that the least amount of projection shall be visible from the frame.
5. Unless otherwise specified hinges shall have concealed ball bearings (combination anti-friction or oil impregnated) and five (5) knuckles.
 - a. Standard doors shall have non-rising pins.
 - b. Doors exposed to the public, and other secure areas, as determined by the Owner, shall have non-removable pins.
6. Electric Hinges: Coordinate voltage and other electrical requirements with applicable portions of Division 16 "Electrical".
7. Continuous Hinges: Unless otherwise specified in the Hardware Sets, continuous hinges shall be stainless steel, steel, or aluminum with a full length Teflon coated stainless steel pin not less than ¼" in diameter.

B. Closers

1. Unless otherwise indicated, closers shall not be visible on the public side of doors. Closers opening into public spaces shall be provided with parallel arms and brackets to suit.
2. Closers shall be sized in accordance with the accepted manufacturer's standards to suit height, width, weight of door and draft conditions.
3. Provide a top pivot for each floor closer.
4. Provide weather sealing compound for each exterior floor closer.

5. Unless specified otherwise in the Hardware Sets, all floor closers shall have a built in dead stop.

C. Locking and Latching Devices

1. Mechanical: Provide types, functions, as specified. Coordinate with Owners keying requirements.
 - a. Unless otherwise specified in the Hardware Sets, tubular style locksets or latchsets will not be accepted in lieu of cylindrical style sets specified.
 - b. Unless otherwise specified in the Hardware Sets, ANSI Grade 3 deadlocks will not be accepted
2. Electric Lock: Electric locks shall be fail safe, unless specified otherwise in accordance with local codes and the authorities having jurisdiction, and shall be deactivated by fire suppression system and devices (local and/or remote) as determined by the Owner.
 - a. Coordinate voltage and other electrical requirements with applicable portions of Division 16 "Electrical".
3. Electric Strike: Electric locks shall be fail safe, unless specified otherwise in accordance with local codes and the authorities having jurisdiction, and shall be deactivated by fire suppression system and devices (local and/or remote) as determined by the Owner.
 - a. Coordinate voltage and other electrical requirements with applicable portions of Division 16 "Electrical".

E. Keys and Keying

1. Coordinate new keying requirements with Owner and existing systems.

F. Stops: Provide stops to limit the degree of opening, helping to prevent damage to adjacent walls, columns, equipment, the door or its hardware.

1. Overhead Stops
 - a. Size overhead stops to suit door width, height, weight and draft condition.
 - b. Overhead stops shall have stainless steel tracks with built-in shock absorber with 5-7 degree compression before dead stop. The arm shall be stainless steel with finish as noted.
2. Floor Stops: All stops to be fastened to concrete shall use expansion shields and machine screws.

G. Pushes and Pulls: Provide concealed fasteners where practical. Where exposed fasteners are required provide flush type finished to match push or pull.

H. Flush Bolts: Provide top and bottom extension type flush bolts, mounted twelve (12) inches and seventy-two (72) inches respectively from the bottom of each door, where scheduled. Provide each bottom flush bolt with a dustproof strike.

I. Silencers: Provide silencers for all non-gasketed and non-weatherstripped frames. Provide three (3) for each single swing door and two (2) for each pair of doors.

- J. Automatic Door Bottoms: Unless otherwise specified in the Hardware Sets, automatic door bottoms shall be actuated with an operating force not to exceed one and one-half (1½) pounds.

2.4 FINISHES

- A. Provide finish hardware with the following finishes unless otherwise shown:

1. Hinges:
 - a. Interior doors: US15
 - b. Exterior doors: US32D
2. Pivots: US15
3. Surface Closers: 689
4. Floor Closers: US15
5. Locksets: US15
6. Exit Devices: US15
7. Stops: US15
8. Pushes, Pulls, Kick Plates: US32D
9. Flush Bolts: US15

PART 3 - EXECUTION

3.1 GENERAL

- A. Make periodic checks during construction in order to ascertain that the finish hardware furnished has been installed correctly. After completion of all construction work, adjust finish hardware to work properly; test all keys and adjust as required for smooth, free operation.
- B. Aluminum Saddles will be provided by Reese Enterprises, where aluminum saddles are noted on the Door Schedule.

3.2 HARDWARE SETS

HARDWARE SET NO. 01 - SINGLE SALTO

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	630	IVE
1	EA	ELECTRICAL CYLINDRICAL LOCKSET	CB250N70CSB3	626	SAL
1	EA	SURFACE CLOSER	4050 REG OR PA AS REQ MWMS	689	LCN
1	EA	KICK PLATE	8400 16" X 1" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	US26D	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE SET NO. 02 - PAIR CORRIDOR

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
6	EA	HINGE	5BB1 SERIES AS SPECIFIED	630	IVE
2	EA	FIRE EXIT HARDWARE	9927-EO-F-LBR-499F	626	VON
2	EA	ELECTRONIC EXIT DEVICE TRIM	SALTO TRIM WITH XS4 - TO SUIT 9927	626	SAL
2	EA	SURFACE CLOSER	4050 CUSH	689	LCN
2	EA	KICK PLATE	8400 16" X 1" LDW B-CS	630	IVE
2	EA	FIRE/LIFE WALL MAG	SEM7850 AS REQ (12/24/120V AC/DC TRI-VOLT)	689	LCN
2	EA	SILENCER	SR64	GRY	IVE

HARDWARE SET NO. 03 - SINGLE EXIT SALTO

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	5BB1 SERIES AS SPECIFIED	630	IVE
1	EA	FIRE EXIT HARDWARE	99-EO-F	626	VON
1	EA	ELECTRONIC EXIT DEVICE TRIM	SALTO TRIM WITH XS4 - TO SUIT 99	626	SAL
1	EA	SURFACE CLOSER	4050 REG OR PA AS REQ MWMS	689	LCN
1	EA	WALL STOP	WS406/407CCV	US26D	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE SET NO. 4 - PAIR EXTERIOR SALTO

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
		HINGE	BY DOOR MANUFACTURER	628	IVE
2	EA	PANIC HARDWARE	33A-EO	626	VON
1	EA	ELECTRONIC EXIT DEVICE TRIM	SALTO TRIM WITH XS4 - TO SUIT 33A	626	SAL
2	EA	SURFACE CLOSER	4050 HCUSH	689	LCN
1	EA	PERIMETER GASKETING	BY DOOR MANUFACTURER		
1	EA	THRESHOLD	BY DOOR MANUFACTURER	A	ZER

HARDWARE SET NO. 5 - SGL EXTERIOR SALTO

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
		HINGE	BY DOOR MANUFACTURER	628	IVE
2	EA	PANIC HARDWARE	33A-EO	626	VON
1	EA	ELECTRONIC EXIT DEVICE	SALTO TRIM WITH XS4 - TO SUIT	626	SAL
		TRIM	33A		
2	EA	SURFACE CLOSER	4050 HCUSH	689	LCN
1	EA	PERIMETER GASKETING	BY DOOR MANUFACTURER		
1	EA	THRESHOLD	BY DOOR MANUFACTURER	A	ZER

END OF SECTION

SECTION 08 81 00

GLASS AND GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Provide glazing materials and installation components and accessories where scheduled, as shown on the drawings and specified in this section.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal, and specified movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, and/or product imperfections, fabrication, and installation; failure of sealants or gaskets; and other defects in construction.
- B. Work shall conform to the most current edition of following standards and codes. Where contradictory requirements are found between standards and/or codes and/or this specification, the more stringent requirement shall govern unless otherwise stated by the Architect.
 - 1. New York State Building Code
 - 2. ANSI Z97.1 American National Standard for Safety Glazing Materials Used in Buildings
 - 3. GANA Glass Association of North America Glazing Manual
- C. Glass Thickness: Select minimum glass thickness to comply with ASTM E 1300.
- D. Minimum thickness of glass lites, whether annealed or heat treated, are to be selected so that the worst case probability of failure does not exceed the percentages listed in the State Building Code.

1.4 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Clear Glass: Obtain clear float glass from one primary-glass manufacturer.
 - 1. Fabricator to have minimum 5 years experience.

- B. Source Limitations for Laminated Glass: Obtain laminated-glass units from one manufacturer using the same type of glass lites and interlayers for each type of unit indicated.
- C. Source Limitations for Glazing Accessories: Obtain glazing accessories from one source for each product and installation method indicated.
- D. Shooter/Attack Glass: Where indicated provide certified Shooter/Attack Glass with UL verified testing following National Safety Security Protection Association protocols.
- E. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.
- F. Provide safety glass where required to satisfy structural requirements, resist human impact loads and as otherwise required by Codes and Standards. Glass panels subject to human impact loads include glass in doors, fixed panels in windows and doors that may be mistaken for means of egress or ingress, where lowest point of panel is less than 18" above finished floor and minimum panel dimension is larger than 18".
- G. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA'S "Glazing Manual" and "Laminated Glass Design Guide."
 - 2. SIGMA Publications: SIGMA TM-3000, "Vertical Glazing Guidelines"

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers.

1.8 WARRANTY

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Manufacturer's Special Warranty on Laminated Glass: Written warranty, made out to Owner and signed by laminated-glass manufacturer agreeing to furnish replacements for laminated-glass units that deteriorate as defined in "Definitions" Article, delivered to a secure location on site, within specified warranty period indicated below.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLAZING SYSTEMS, GENERAL

- A. Unless specific products are designated as proprietary, it is intended that each type of glazing system be selected by the fabricator for the individual systems for doors.

2.2 PRIMARY FLOAT GLASS

- A. Low Iron Float Glass: Starphire Ultra Clear or equal, ASTM C 1036, Type I (ultra clear transparent glass, flat), Quality q3 (glazing select); Class 1.

2.3 HEAT STRENGTHENED, AND FULLY TEMPERED GLASS

- A. General: Glass which has been heat treated horizontally; maintain roller marks running horizontally in the final installation whenever possible. For glass which has been heat treated vertically, locate tong marks along an edge, oriented in the same direction which will be concealed in the glazing system.
 - 1. Overall Bow and warp tolerances: Heat treated glass shall be examined by the glass manufacturer to detect and discard any lites which exceed 50% maximum bow in any direction, as listed ASTM C1048 Tables.
 - 2. Roll ripple tolerances: Where heat treatment process results in essentially parallel ripples of waves, the deviation from flatness at any peak shall not exceed 0.005 inches.
 - 3. Quench marks to shall be consistently oriented horizontally.
 - 4. Incorporate the heat soak process to control nickel sulfide inclusions and reduce risk of spontaneous breakage of installed glass. Heat soaking shall be performed per EN 14179-1:2005– European Heat Soaking Standard.
 - 5. Comply with ASTM C 1048; Type I (transparent glass, flat); Quality q3 (glazing select); class, kind, and condition as indicated in schedules at the end of Part 3.

2.4 LAMINATED GLASS

- A. Laminated Glass: Comply with ASTM C 1172 for kinds of laminated glass indicated and other requirements specified.
- B. Interlayer: Interlayer material as indicated below, clear or in colors, and of thickness indicated with a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after laminating glass lites and installation.
 - 1. Interlayer Material: Polyvinyl butyral sheets.
 - 2. Laminate material at edges, not to be exposed to UV light or deterioration
 - 3. Laminate lites with polyvinyl butyral interlayer in autoclave with heat plus pressure.

- C. Safety glass shall have permanent marking sandblasted or ceramic frit logo.

2.5 SHOOTER/ATTACK GLASS

- A. Provide Armoured One Shooter Attack Glass or approved equal consisting of three lites of glass with security interlayers and surface security film. Provide 5/8" and 1" thick products with ratings indicated on Drawings.
- B. Provide manufacturer's recommended glazing adhesives to achieve indicated ratings.

2.6 GLASS SCHEDULE

- A. General: the following descriptions include minimum thicknesses and strengths of glass required and interspace gas. Where thicker or stronger glass, or argon gas fill is required to meet the performance criteria herein, including acoustic performance, wind loads and thermal stress it shall be provided by the contractor at no additional cost. "Types" indicated below refer to acoustic performance requirements.
- B. Safety Glass: The glass types in this schedule shall be modified to include Fully Tempered (FT) safety glass where indicated and at doors and locations where edge of glass is within 18" of surface used by pedestrians.
- C. Glass Types:
 - 1. 3/8" LAMINATED SAFETY GLASS
 - a. Inner Lite: 3/16" Type I (transparent glass, flat) Class 1, clear, float glass. Kind HS (heat strengthened) or FT (fully tempered)
 - b. PVB innerlayer
 - c. Outer Lite: 1/8" Type I (transparent glass, flat) Class 1, clear, float glass. Kind HS (heat strengthened) or FT (fully tempered)
 - 2. 5/8" (45 Minute Fire Rated) SHOOTER ATTACK GLASS
 - a. Inner Lite: 1/8" Type I (transparent glass, flat) Class 1, clear, float glass. Kind HS (heat strengthened) or FT (fully tempered)
 - b. Fire rated ballistic PVB innerlayer
 - c. Center Lite: 5/16" Type I (transparent glass, flat) Class 1, clear, float glass. Kind HS (heat strengthened) or FT (fully tempered)
 - d. Fire rated ballistic PVB innerlayer
 - e. Outer Lite: 1/8" Type I (transparent glass, flat) Class 1, clear, float glass. Kind HS (heat strengthened) or FT (fully tempered)
 - f. Outer surface ballistic security film.
 - 3. 1" (90 Minute Fire Rated) SHOOTER ATTACK GLASS
 - a. Inner Lite: 1/4" Type I (transparent glass, flat) Class 1, clear, float glass. Kind HS (heat strengthened) or FT (fully tempered)
 - b. Fire rated ballistic PVB innerlayer
 - c. Center Lite: 7/16" Type I (transparent glass, flat) Class 1, clear, float glass. Kind HS (heat strengthened) or FT (fully tempered)
 - d. Fire rated ballistic PVB innerlayer
 - e. Outer Lite: 1/4" Type I (transparent glass, flat) Class 1, clear, float glass. Kind HS (heat strengthened) or FT (fully tempered)
 - f. Outer surface ballistic security film.
 - 4. Double-Glazed Sputter-Coated Insulating Glass Units: ASTM E 2190.
 - a. Outboard Lite: Sputter-coated clear float glass.
 - 1) Annealed Clear Float Glass: ASTM C 1036, Type 1, Class 1, Quality q3.
 - 2) Vacuum Deposition Sputtered Coating: ASTM C 1376.

- 3) Coating on Surface No. 2: SunGuard SuperNeutral 68 (SN 68).
- 4) Glass Thickness: 6 mm (1/4 inch).
- 5) Heat Treatment: None
- b. Air Space: 12 mm (1/2 inch) wide, hermetically sealed, dehydrated air space.
- c. Inboard Lite: Guardian Clear float glass.
 - 1) Annealed Clear Float Glass: ASTM C 1036, Type 1, Class 1, Quality q3.
 - 2) Glass Thickness: 6 mm (1/4 inch).
 - 3) Heat-Treatment: Tempered; ASTM C 1048, Kind FT; CPSC 16CFR-1201;
 - 4) ANSI Z 97.1.
- d. 5. Glass Unit Performance Characteristics:
 - 1) Visible Light Transmittance: 68 percent
 - 2) Visible Light Reflectance Outdoors: 11 percent
 - 3) Direct Solar Energy Transmittance: 33 percent
 - 4) Direct Solar Energy Reflectance Outdoors: 33 percent
 - 5) Winter U-Value Nighttime: 0.29
 - 6) Summer U-Value Daytime: 0.28
 - 7) Solar Heat Gain Coefficient: 0.38
 - 8) Summer Relative Heat Gain: 90
- e. Edge Seals: ASTM E 2188, with aluminum spacers, dual-sealed with a primary seal of polyisobutylene and a secondary seal of silicone sealant for glass to spacer seals.

2.7 GLAZING SEALANT

- A. Medium-Modulus Neutral-Curing Silicone Glazing Sealant: Provide products complying with the following:
 - 1. Products: Provide the following, or equal as approved by the architect:
 - a. Dow 795 Dow Corning.
 - b. GE Silpruf SCS2000
 - c. Pecora 895 NST
 - 2. Type and Grade: S (single component) and NS (nonsag).
 - 3. Class: 25.
 - 4. Use Related to Exposure: NT (nontraffic).
 - 5. Uses Related to Glazing Substrates: M, G, A, and, as applicable to glazing substrates indicated, O.
 - a. Use O Glazing Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating.
 - 6. Applications: General glazing applications, particularly those for large lights and similar applications where additional movement capability is required.
- B. For Shooter Attack Glass Applications, provide glass manufacturer's proprietary formulation to maintain required ratings.

2.8 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based, (silicone sealant at all butyl tape exposed to UV light) elastomeric tape with a solids content of 100 percent; non-staining and

non-migrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where interior use where indicated.
2. AAMA 806.3 tape, for general glazing applications, all exterior and applications in which tape is subject to continuous pressure.
3. Alternate: Silicone tape.

2.9 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealants: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Silicone with a Shore A durometer hardness of 85, plus or minus 5.
- D. Spacers: Silicone blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Silicone material of hardness needed to limit glass lateral movement (side walking), 50+/- Shore Durometer hardness.

2.10 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

- A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.2 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazing channel dimensions, as indicated on drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thickness, with reasonable tolerances. Adjust and correct s required by project conditions during installation.

- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply cleaners and primers to joint surfaces where required application and for adhesion of sealants, as determined by pre-construction sealant-substrate testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead. Install at 1/4 points unless otherwise instructed by the glass manufacturer.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Stops: Install and secure as indicated, after glazing has been set in frame. Do not exert excess force no glazing and spacers.

3.3 GASKET GLAZING (DRY)

- A. Insert soft and hard compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners with joint seals and/or molded, welded corners.
- B. Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weather tight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer. Seal horizontal and vertical metal extrusion to receive gasket at all corners.
- C. Install gaskets so they protrude past face of glazing stops.

3.4 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 PROTECTION AND CLEANING

- A. Remove and replace glass that is broken, chipped, cracked, or abraded.

- B. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer and GANA guidelines. Do not use razor blades, scrapers or other metal tools to clean glass.

END OF SECTION 08 81 00

SECTION 08 88 13

INTERIOR FIRE RATED FULL GLASS DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to, the following:
 - 1. 90 minute rated full glass door systems, including frame, door panels, hardware, seals, glass and glazing; with sizes and configurations as shown on drawings.

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to:
 - 1. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section
 - 2. Section 08 81 00 - Glazing: Glass and glazing accessories

1.4 SUBMITTALS

- A. Product Data: Manufacturer's literature including independently tested data listing performance criteria and Owner's Manual with installation instructions.
- B. Shop Drawings: Indicate dimensioning, direction of swing, configuration, swing panels, typical head jamb, side jambs and sill details, type of glazing material, and handle height.
- C. Hardware Schedule: Complete itemization of each item of hardware to be provided for each panel, cross-referenced to panel identification numbers in Contract Documents.
- D. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing fire rated interior door systems with a minimum three years of documented experience. Single source manufacturer..
- B. Installer Qualifications: Installer experienced in the installation of manufacturer's products or other similar products for large openings. Installer to provide reference list of at least 3

projects of similar scale and complexity successfully completed in the last 3 years.

- C. Performance Requirements: Provide from manufacturer that has independently tested typical units.
 - 1. Fire Rating: must meet 90 or 120 minutes as specified.
 - 2. Fire Resistive Wall Assembly Certifications: must meet 120 minute fire resistive wall assemblies tested in accordance with ASTM E119, NFPA 251, UL 263 and ULC-S101.
 - 3. Fire Resistive, Temperature Rise Door Assembly Certifications: must meet 90 minute fire resistive temperature rise door assemblies tested in accordance with NFPA 252, UL 10B, UL 10C and CAN4 S104. Must meet 250 degrees F/450 degrees F temperature rise door requirements.
 - 4. Fire Protective Door Assembly Certifications: must meet 90 minute fire protective door assemblies shall be tested in accordance with NFPA 80, NFPA 252, ASTM E152, ASTM E2074, UL 10B, UL 10C and CAN4-S104.

1.6 WARRANTY

- A. Provide manufacturer's warranty against defects in materials and workmanship. Warranty Period: Five years from date of substantial completion.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage. Sequence deliveries to avoid delays, but minimize on-site storage.

1.8 COORDINATION

- A. Conference: Convene a pre-installation conference to establish procedures to coordinate this work with related and adjacent work.
- B. Coordination: Furnish inserts and anchors which must be built into other work. Work closely with installers of finish materials, so that doors are aligned and installed flush with adjacent finishes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of design: Design is based on products manufactured by Safti First.
 - 1. Framing: GPX system
 - 2. Glazing: SuperLite II-XL 90

2.2 MATERIALS AND PRODUCTS

- A. Frame and Panels: From manufacturer's standard profiles, provide head track, side jambs, and panels with dimensions shown on drawings.
 - 1. Provide panels with: Standard one lite as shown on drawings].
 - 2. Provide standard bottom rail.
 - 3. Window/Wall Frame thickness: 2-1/2" Standard. 3", 4-1/8" and 5" also available. Door profile thickness: 5" Standard.
 - 4. Fire resistive aluminum door capable of accommodating concealed hardware.
 - 5. Internal framing: Internal tube steel framing shall conform to ASTM A501. Formed steel retainers shall be galvanized conforming to ASTM A527.
 - 6. Insulation: The framing system shall insulate against the effects of fire, smoke and heat transfer from either side. The perimeter of the framing system to the rough opening shall be firmly packed with mineral wool fire stop insulation or appropriately rated intumescent sealant.
 - 7. Fasteners: Type recommended by manufacturer. No exposed fasteners allowed.
 - 8. Glazing accessories: The glazing material perimeter shall be separated from the perimeter framing system with approved flame retardant glazing tape. The SuperLite glazing panel shall be caulked continuously around the edge to the tube steel frame utilizing neutral cure silicone. Silicone setting blocks recommended.
- B. Glass:
 - 1. All glass to comply with safety glazing requirements of ANSI Z97.1 and CPSC 16CFR 1201. Provide manufacturer's standard glass with dry glazing with glass stops on the inside only: 1/4 inch (6 mm) clear monolithic tempered.
 - 2. SuperLite II-XL 90 Starphire.
- C. Locking Hardware and Handles:
 - 1. Manufacturer's standard point lock with panic device on the inside and lever on the outside with keyed cylinder.
- D. Other Components:
 - 1. Seals: Provide manufacturer's standard non-broken EPDM seals.

2.3 FABRICATION

- A. Assemblies shall be furnished [knocked down for field assembly and will be glazed in the field] [assembled (should configurations and job site conditions allow)] [unitized (should configurations and job site conditions allow)] .
- B. Door assemblies shall be factory prepared for field mounting of hardware.
- C. Sizes and Configurations: See drawings for selected custom dimensions. See drawings for selected number of panels and configuration. Provide each assembly manufactured as a complete unit, ready for installation with all necessary parts.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section. Beginning work means Installer accepts substrates and conditions.
- B. Coordinate installation with related and adjacent work. Set frames accurately into position and securely fasten truly plumb and level and in proper alignment with adjacent finishes. Set doors so that frames are in full contact with surrounding construction on entire perimeter.
- C. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- D. Provide alignment attachments and shims to permanently fasten system to building structure.
- E. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
 - 1. Maximum Variation from Plumb: 0.06 inches every 3 ft (1.5 mm/m) non-cumulative or 1/16 inches per 10 ft (1.5 mm/3 m), whichever is less.
 - 2. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch (0.8 mm).
- F. Install glass and infill panels in accordance with Section 08 8100, using glazing method required to achieve performance criteria.
- G. Install perimeter sealant in accordance with Section 07 92 00.

3.2 ADJUSTING, CLEANING, & PROTECTION

- A. Adjust operating parts to work easily, smoothly, and correctly.
- B. Touch-up damaged coatings and finishes to eliminate evidence of repair.
- C. Repair minor damage to eliminate all evidence of repair. Remove and replace work which cannot be satisfactorily repaired.
- D. Clean exposed surfaces using materials and methods recommended by manufacturer of material or product being cleaned. Remove and replace work that cannot be successfully cleaned.

END OF SECTION

SECTION 09 21 16

GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to, the following:

1. Metal framing and trimming systems for drywall systems.
2. Gypsum boards for wall, ceiling and soffit applications.
3. Cementitious tile backer board, interior.
4. Gypsum board finishes.
5. Sound attenuation insulation.
6. Concealed acoustical sealants.
7. Miscellaneous metal framing and blocking.
8. Installation of access panels.

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to:
 1. Section 06 10 00, Rough Carpentry; Blocking and wood studs.
 2. Section 07 84 00, Firestopping; Firesafing insulation and sealant.
 3. Section 07 92 00, Joint Sealants; Exposed acoustical sealant.
 4. Section 08 31 00, Access Panels; Built into gypsum construction.
 5. Section 09 91 00, Painting; Finishing of work of this section.
 6. Division 22, Plumbing, Division 23 - HVAC and Division 26 - Electrical; Coordination of mechanical, electrical and plumbing requirements.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations for each material used. Provide certifications stating that materials comply with requirements.
- C. Calculations: If spans exceed manufacturer's deflection tables, provide professionally prepared calculations and certification of the performance of this work. Show how design load requirements and other performance requirements have been satisfied.

1.5 QUALITY ASSURANCE

- A. Source: For each type of material required for the work of this section, provide primary materials which are the products of one manufacturer. Provide secondary materials which are acceptable to the manufacturers of the primary materials.
- B. Structural Performance:
 - 1. Limit deflection to $L/240$ for non-rigid finishes, $L/360$ for rigid finishes applied over drywall. Lateral load is 10 p.s.f.
- C. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by a qualified independent testing agency, acceptable to the Architect and authorities having jurisdiction.
- D. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency, acceptable to the Architect and authorities having jurisdiction.
 - 1. Acoustical performance of partitions is critical to the work of this section. Drawings indicate required STC ratings in partitions types. This includes partition types with dual stud framing for separation as well as partitions which include resilient isolation clips.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturers' instructions and recommendations. Protect from damage. Adequately support stored gypsum panels to avoid sagging. Sequence deliveries to avoid delays, but minimize on-site storage.

1.7 PROJECT CONDITIONS

- A. Framing Tolerances: Proceed with work only when framing work is complete and within installation tolerances specified in ASTM C754 and this specification section.
- B. Ventilation: Comply with manufacturer's requirements and recommendations and Gypsum Association publication 216. Avoid too rapid drying in hot weather.
- C. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Metal Framing and Support: Provide products of one of the following manufacturers if they meet or exceed the requirements of these specifications:
 - 1. MarinoWare; Division of Ware Ind
 - 2. Dietrich Industries, Inc.
 - 3. National Gypsum Co.
- B. Gypsum Board and Related Products: Provide products of one of the following manufacturers if they meet or exceed the requirements of these specifications:
 - 1. Georgia-Pacific Corp.
 - 2. National Gypsum Co.
 - 3. USG.

2.2 METAL FRAMING AND SUPPORTS

- A. Studs: ASTM C645, .0147 inch thickness minimum, unless otherwise recommended by manufacturer for conditions, span and deflection constraints indicated. Provide galvanized steel studs with not less than ASTM A 653, G60, hot-dip galvanized zinc coating.
 - 1. Depth: As indicated on drawings and as required by span and deflection constraints.
 - 2. Minimum .0181 inch thickness studs at VHI abuse resistant panels.
- B. Sound Control Studs: Dual stud system with factory installed isolator. Soundguard as manufactured by MarinoWare or approved equivalent.
- C. Runners: Match studs. Provide type as recommended by stud manufacturer.
- D. Furring: ASTM C 645, .0147 thickness, except .0181 where span exceeds 4'; hat shaped or Z-shaped as indicated or appropriate. Provide galvanized steel furring with not less than ASTM A 653, G60 coating. Where indicated or required to achieve sound transmission classifications, provide special resilient sound transmission reducing isolation clips: RSIC-01 as manufactured by PAC International or ISOMax as manufactured by Kinetics.
- E. Cold Rolled Channel Bridging: Steel, 0.0538-inch minimum base-metal thickness, with minimum 1/2-inch-wide flanges.
- F. Hanger Rods: Where required for loading or by local authorities, provide mild-steel rods, sized as required, hot-dip galvanized.
- G. Flat Hangers: Where required for loading or by local authorities, provide mild-steel flat hangers, sized as required, hot-dip galvanized.
- G. Angle-Type Hangers: Provide steel angles with legs not less than 7/8 in. wide, formed from 0.0635 in thick galvanized steel sheet conforming to ASTM A 653, G 90, with bolted connections.
- H. Resilient Hangers: USG Interiors RC-1, Dietrich "RCSS" or "RCSN", or approved equal.
- I. Steel Flat Strap and Backing Plate: Steel sheet for blocking and bracing, in length and width as indicated, and with a minimum base metal (uncoated) thickness of 0.0179 inch thick.

2.3 GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C36.
 - 1. Types: Fire-resistant type X and type C. Refer to Wall Partition Schedule on the Drawings. Provide mold resistant type at all exterior walls and at interior walls and ceilings of bathrooms, kitchens and other areas where moisture may be present.
 - 2. Edges: Tapered.
 - 3. Thicknesses: 5/8", and as indicated.
- B. Tile Backer Units: Provide one of the following:
 - 1. Cementitious: ANSI A118.9 and ASTM C 1325, cement-coated Portland cement, USG Durock or Custom Building Products Wonderboard or approved equal, nominal 5/8 inch thick.
- C. Abuse Resistant Gypsum Panels: Thickness as indicated on the Drawings. Provide the following:
 - 1. Provide at public corridors and where noted on Drawings: U. S. Gypsum Co. "Fiberock AR" abuse resistant panels with "Hard Body Impact" resistance. Gypsum board panels faced with heavy weight paper face and liner, and with paper facing folded around the long edges; panels shall conform to ASTM C 36 and have an impact resistance of 84 ft. lbs. At fire-rated construction provide Type X Fiberock AR.

2.4 METAL TRIMS AND ACCESSORIES

- A. Provide the following USG trim and accessory types or Architect approved equals from a specified manufacturer:
 - 1. Corner Bead: USG No. 800.
 - 2. Control Joint: USG No. 093.
 - 3. Edge Trim: USG No. 200-A and 200-B for drywall. Series 400 trim is not acceptable.
- B. Interior Work: Galvanized steel trim units of types specified.
- C. Reveals: Factory-primed extruded aluminum reveal by Fry Reglet, Pittcon or approved equal, sizes as indicated on the Drawings.
- D. Control Joints: Provide control joints complying with ASTM C 1047 and requirements indicated below:
 - 1. Material: Steel sheet coated with aluminum or rolled zinc.
 - 2. Type: One-piece control joint formed with V-shaped slot and removable strip covering slot opening.
- E. Accessory for Curved Edges: Cornerbead formed of metal, plastic, or metal combined with plastic, with either notched or flexible flanges that are bendable to curvature radius.

2.5 JOINT MATERIALS

- A. General: Comply with ASTM C475.
- B. Tape: Provide perforated, cross-fiber paper or fiberglass reinforcing.
- C. Joint Compound: Provide ready mixed vinyl compound, unless indicated otherwise.

2.6 MISCELLANEOUS MATERIALS

- A. Concealed Acoustical Sealant: Non-drying, non-hardening, non-bleeding, non-staining sealant complying with ASTM C919. Provide one of the following:
 - 1. Pecora BA-98.
 - 2. Tremco Acoustical Sealant.
 - 3. USG Acoustical Sealant.
- B. Sound Attenuation Insulation: ASTM C 665, Type I. At acoustical partitions, provide Thermafiber sound attenuating fire blanket or approved equal with 2.5 lbs/cu.ft density meeting fire characteristics of Thermafiber. Provide clips or wires to hold insulation in place as applicable.
- C. Laminating Adhesive: Use joint compound or adhesive that is recommended by gypsum board manufacturer for laminating gypsum boards.
- D. Screws: Comply with ASTM C646 and C514. Type S, bugle head, for attaching gypsum panels to steel framing. Provide other types as recommended by gypsum board manufacture. Provide cadmium plated fasteners for all fasteners in wet or humid areas.
- E. Anchors: Provide screws, bolts, powder actuated fasteners, inserts and other fasteners that are customarily used in standard construction practices and which are proven capable of supporting at least 3 times design load.

PART 3 - EXECUTION

3.1 INSPECTION

- A. The Installer/Erector shall examine substrates, supports, and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means Installer accepts substrates and conditions.

3.2 INSTALLATION

- A. General Requirements: Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section.
 - 1. Furniture Layout: Coordinate and guarantee dimensions required for custom millwork items fitting into wall construction.

- B. Framing: Install/erect framing to comply with ASTM C754. Provide framing to comply with published details and recommendations of gypsum board manufacturer, or if not available, comply with U. S. Gypsum, Gypsum Construction Handbook. Erect ceiling framing system to comply with RS 5-16 supported only from building structure.
1. Do not bridge building joints; frame separately on both sides and allow for movement.
 2. Isolate framing system from structural loading both horizontally and vertically.
 3. Provide slip or cushioned joints at top of walls. Maintain lateral stability and acoustical performance.
 4. Terminate partitions [framing and wallboard] at structural deck above, except as noted otherwise.
 5. Where gypsum wallboard is noted to terminate above ceilings, continue framing to deck above.
 6. Space framing members at 16"o.c., unless indicated otherwise. Meet deflection requirements.
 7. Provide metal blocking at areas to receive rails, cabinets, window treatment, furnishings, shelving, and similar items requiring support unless indicated to receive wood blocking.
 8. Isolate components of framing with resilient clips or separate dual framing as indicated on Drawings to achieve sound transmission classifications. Do not permit bridging or blocking to bridge sound separated or resilient isolation features of partitions.
 9. Ensure maintenance of fire rating and acoustical rating at areas with built-in or recessed items such as fire extinguisher cabinets, furnishings and similar items.
- C. Gypsum Board Installation: Install gypsum board in strict compliance with ASTM C 840 and Gypsum Association publication 216, Recommended Specifications for the Application and Finishing of Gypsum Board. Refer to partition schedule and details on the Drawings. Unless indicated otherwise, between offices one layer of gypsum board shall extend to structure above on each side of metal stud. Unless indicated otherwise, between offices and corridors, one layer of gypsum board shall extend to structure above.
1. Locate joints between boards as far from center of walls and ceilings as possible.
 2. Stagger vertical joints on opposite sides of walls and in multiple layer work.
 3. Install gypsum boards with face side out and with joints over framing members.
 4. Do not butt dissimilar board edges.
 5. Provide one-piece boards around door and window frames.
 6. Cover both faces of stud partitions.
 7. Attach boards to metal framing with self-tapping, bugle head screws.
 8. Space fasteners as recommended by gypsum board manufacturer.
 9. Install drywall ceilings prior to gypsum board walls, to the greatest extent possible.
 10. In multiple layer walls, provide backing board or multiple layers of face board.
 11. Form control joints by preparing space between edges to receive metal control joint trim.
 12. Provide materials to maintain acoustical and fire rating of walls at built-in items such as fire-extinguisher cabinets.
- D. Cementitious Backer Unit Installation: Install cementitious backer boards in strict compliance with ANSI A108.11 and manufacturer's requirements.
- E. Metal Trim: Strictly comply with manufacturer's instructions and recommendations for installation of metal trims and accessories. Meet installation tolerance requirements.

1. Provide corner bead trim at all external corners. Provide joint reinforcing tape at all internal corners.
 2. Provide control joints where shown and at less than 30' o.c. at locations approved by Architect.
 3. Provide edge trim wherever edge of gypsum board is exposed, revealed, or sealant filled, or as noted on Drawings.
- F. Acoustical Insulation Work: Provide sound attenuation insulation where indicated and where required to obtain STC ratings indicated. Use clips or wires to hold insulation in place. Stuff flutes in metal deck with acoustical insulation, except stuff flutes with firesafing insulation for fire-rated partitions.
- G. Acoustical Sealing Work: Provide continuous bead of concealed acoustical sealant at both faces of top and bottom runner tracks, wall perimeters, openings, expansion and control joints. Close off all sound flanking paths and openings, including those above ceilings.

3.3 JOINT FINISHING

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
1. Extend joint finishing to floor behind wall base to provide a smooth flat surface for installation of wall base.
 2. For water-resistant board applications, use special water-resistant joint compound to seal joints, cover fastener heads, fill surface defects and seal cut edges.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
 2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile and where indicated.
 3. Level 5: At all exposed locations. All joints and interior angles shall have tape embedded in joint compound and immediately wiped with a joint knife or trowel, leaving a thin coating of joint compound over all joints and interior angles. Two separate coats of joint compound shall be applied over all flat joints and one separate coat of joint compound applied over interior angles. Fastener heads and accessories shall be covered with three separate coats of joint compound. A thin skim coat of joint compound shall be trowel applied to the entire surface. Excess compound is immediately sheared off, leaving a film or skim coating of compound completely covering the paper.

- E. Cementitious Tile Backer Units: Finish according to manufacturer's written instructions.

3.4 TOLERANCES

- A. The following allowable installed tolerances are allowable variations from locations and dimensions indicated by the Contract Documents and shall not be added to allowable tolerances indicated for other work.
 - 1. Allowable Variation from True Plumb, Level, & Line: $\pm 1/8"$ in 20'-0".
- B. After finishing joints and screw heads shall be flush and not visible. Surfaces shall appear truly flush, smooth, seamless and uniform. Planes shall be truly flat. Corners shall be crisp and at true angles. Where gypsum drywall work butts dissimilar materials, joints shall be tight and shall be accurately scribed to adjacent construction without gaps.

3.5 REPAIR

- A. Repair minor damage to eliminate all evidence of repair. Remove and replace work which cannot be satisfactorily repaired. Clean up all joint compound splatters.

END OF SECTION

SECTION 09 51 23

ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to, acoustical ceiling systems including suspension systems as specified and as detailed on the Drawings.

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect Work of this Section. Other Specification Sections that directly relate to Work of this Section include, but are not limited to:
 - 1. Section 09 21 16, Gypsum Drywall; drywall ceilings and soffits.
 - 2. Section 09 81 29, Sprayed Acoustic Insulation; sprayed acoustical ceiling treatment.
 - 3. Division 21 – Fire Suppression, sprinklers located in ceilings.
 - 4. Division 23 - HVAC; grilles, and diffusers located in ceilings.
 - 5. Division 26 - Electrical; light fixtures and alarm system components located in ceilings.
 - 6. Division 27 - Communications, audio-visual equipment located in ceilings.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations for each material used. Provide certifications stating that materials comply with requirements.
- B. Verification Samples: Submit representative samples of each material that is to be exposed in the finished work, showing the full range of color and finish variations expected. Provide samples having minimum area of 144 square inches.
- C. Test Reports: Submit certified reports for tests required.
- D. Coordination Drawings: Provide drawings indicating all items of all trades to be installed in ceiling systems and showing required clearances and closures.

1.5 QUALITY ASSURANCE

- A. Source: For each type of material required for the work of this section, provide primary materials which are the products of one manufacturer. Provide secondary materials which are acceptable to the manufacturers of the primary materials.

1.6 TESTS

- A. Fire-Resistance: Where fire-resistance ratings are indicated or required by authorities having jurisdiction, provide materials and construction which are identical to assemblies whose fire-resistance rating has been tested in compliance with ASTM E119 by independent agencies acceptable to the Architect and authorities having jurisdiction.
- B. Burning Characteristics: Provide materials whose surface burning characteristics, when tested in compliance with ASTM E84 are Class A or Class 1.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage, moisture and direct sunlight. Sequence deliveries to avoid delays, but minimize on-site storage.

1.8 PROJECT CONDITIONS, SEQUENCING AND SCHEDULING

- A. Environment: Perform work only when conditions are within the limits established by manufacturers of the materials and products used.
- B. Conference: Convene a pre-installation conference to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.
 - 1. Proceed with installation of ceiling tiles and panels only when construction above ceilings and penetrating work is complete.
 - 2. Perform work of this section to coordinate with the layout of light fixtures, HVAC equipment and fixtures, fire suppression system components and all other related work. In general, every penetration shall occur at the center of a ceiling tile or panel.

1.9 EXTRA MATERIAL

- A. Provide packaged, wrapped and labeled maintenance stock equal to 2% of the actual quantity installed for the following items of work:
 - 1. Each type of ceiling tile and panel.
 - 2. Each type of suspension system component.

PART 2 - PRODUCTS

2.1 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:
1. Armstrong World Industries, Inc.
 2. USG Interiors, Inc.
 3. Certainteed.

2.2 SUSPENDED ACOUSTICAL CEILINGS

- A. Basis of Design: Armstrong Optima 2 x 2 Square Lay-In 1" fiberglass ceiling tiles, White. Equivalent products by the following may also be considered subject to approval of the Architect:
1. Certainteed
 2. USG
- B. Tile properties
1. Fire performance: Class A. ASTM E84 flame spread 25 or less, smoke developed 50 or less.
 2. NRC: 0.95
 3. Light reflectance: 0.90
 4. Humidity and sag resistant.
 5. Washable surface.
 6. Mold/mildew resistant.
 7. Formaldehyde free.
 8. Greenguard Gold Certified for emissions.

2.3 SUSPENSION SYSTEMS

- A. Basis of Design: Armstrong Prelude 15/16" White. Equivalent products by the following may also be considered subject to approval of the Architect:
1. Certainteed
 2. USG
- B. Suspension Systems: Provide suspension systems complying with requirements of ASTM C635 for Heavy Duty Systems. Provide suspension system to suit ceiling tiles specified. Provide lay-in suspension systems with 100% accessibility. Locate accessible tiles where required or field directed for access to controls, valves and equipment.
- C. Attachment Devices: Provide and size for 5 times design load indicated in ASTM C635, Table 1, direct hung.
- D. Moldings and Trim: Provide perimeter edge trim and fascia trim profiles as shown on Drawings to suit edge conditions, panel profile and penetrations. Provide custom fabricated work as necessary to provide exact fit.

- E. Basis of Design for Fascia Trim: Armstrong Axiom Classic, Blizzard White. Equivalent products by the following may also be considered subject to approval of the Architect:
 - 1. Cetainteed Terminus
 - 2. USG 8" Edge Trim

PART 3 - EXECUTION

3.1 INSPECTION

- A. The Installer shall examine substrates, supports, and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means Installer accepts substrates and conditions.

3.2 PREPARATION & INSTALLATION

- A. General Requirement: Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section.
- B. Coordination: Coordinate installation with other work to ensure proper location of related work such as light fixtures, mechanical fixtures, fire protection systems and the like.
- C. Layout: Measure each area and layout ceilings to balance panel widths on opposites edges of each ceiling in both directions unless otherwise noted. Avoid use of less than 1/2 width ceiling units wherever possible.
- D. Suspension Installation: Erect suspension system supported only from building structure. Level main suspension members to within tolerance of 1/8" in 12'. Splay hangers where necessary and countersplay to balance resulting horizontal forces. Cross brace suspension to prevent lateral sway and displacement during full seismic load prescribed by code.
- E. Edge Moldings and Trim: Provide edge moldings at entire perimeter of ceiling, at columns, and wherever necessary to conceal edges of acoustical units. Miter corners of edge moldings accurately and connect securely.
 - 1. Do not use exposed fasteners nor pop rivets.
 - 2. Sealing: Provide a continuous bead of exposed acoustical sealant, specified in Section 07 92 00 - Joint Sealants, between edge moldings and walls.
- F. Ceiling Panel Installation: Use clean white gloves when handling ceiling materials. Install ceiling panels in coordination with suspension system. Scribe and cut panels to fit accurately.
 - 1. Orientation: Lay panels with grain [if any] running in one direction throughout the project.
 - 2. Square Edge: Field cut and paint edges of tiles cut in field to produce painted edge at all tile.

3.3 ADJUSTING, TOUCH-UP, CLEANING

- A. Adjust panels so that ceilings are in one plane and look uniform with no individual panels too high or too low.
- B. Touch-up damaged suspension system coatings and finishes and repair minor damage to eliminate all evidence of repair. Remove and replace work which cannot be satisfactorily repaired.
- C. Clean exposed surfaces using materials and methods recommended by manufacturer of material or product being cleaned. Remove and replace work that cannot be successfully cleaned.

END OF SECTION

SECTION 09 65 00

RESILIENT FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to, the following:
 - 1. LVT tile and plank flooring.
 - 2. Resilient wall base.
 - 3. Resilient reducer strips and trim pieces.
 - 4. Subfloor preparation.

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect Work of this Section. Other Specification Sections that directly relate to Work of this Section include, but are not limited to:
 - 1. Section 03 30 00, Cast-In-Place Concrete.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations for each material and product used. Provide certifications stating that materials comply with requirements and applicable fire ratings.
- B. Verification Samples: Submit representative samples of each material that is to be exposed in the finished work, showing the full range of color and finish variations expected. Provide flooring samples having minimum area of 144 square inches. Provide 6 inch lengths of base and trim pieces.

1.5 QUALITY ASSURANCE

- A. Source: For each type of flooring product required for the work of this section, provide primary materials and products which are the products of one manufacturer. Provide secondary materials such as adhesives which are acceptable to the manufacturers of the primary materials.
- B. Installer Qualifications: Acceptable to manufacturer of resilient flooring for the requirements

of the project.

C. Sustainable Design Requirements:

1. ISO 14001 Environmental Management Systems certification.
2. Construction waste take back program for the purpose of reducing jobsite waste by taking back uninstalled waste flooring.
3. Flooring surfaces that are easily cleaned and do not require coatings and stripping, or use chemicals that may be hazardous to human health.
4. Flooring that is free of materials known to be teratogenic, mutagenic or carcinogenic.
5. Flooring that contains no polyvinyl chloride or plasticizers.
6. Flooring that contains no halogens.
7. Flooring that contains no asbestos.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage.
- B. Sequence deliveries to avoid delays, but minimize on-site storage.

1.7 PROJECT CONDITIONS, SEQUENCING AND SCHEDULING

- A. Conference: Convene a pre-installation conference to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.
- B. Environment: Perform work only when temperature and humidity conditions are within the limits established by manufacturers of the materials and products used. Provide continuous exhaust through vent windows during cement/adhesive application.
- C. Substrates: Proceed with work only when substrate construction and penetrating work is complete. To the greatest extent possible, perform work of this section after other finishing operations such as painting have been completed.
- D. Subfloors: Ensure that concrete subfloors are properly cured and sufficiently dry by making bond and moisture tests as recommended by flooring manufacturer. Coordinate work of this section with work of Section 03 30 00, Cast-In-Place Concrete, to ensure that concrete curing compounds used do not interfere with adhesion of resilient flooring.
 1. Concrete Substrates: Prepare according to ASTM F 710-08.
 - a. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - b. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 - c. Moisture Testing:
 - 1) Perform anhydrous calcium chloride test, ASTM F 1869-04. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
 - 2) Perform tests recommended by manufacturer. Proceed with installation only

- after substrates pass testing.
- d. Adhesion Bond Test: After substrate has been properly prepared perform adhesion bond test as recommended by the manufacturer.

PART 2 - PRODUCTS

2.1 LUXURY VINYL TILE (LVT) FLOORING

- A. Refer to the Finish Schedule on Interior Drawings for type, colors, patterns and locations.
- C. Heavy Commercial Luxury Vinyl Tile, ASTM F1700, Class III, Type B.
 - 1. Flammability: NFPA 253 Class 1
 - 2. Smoke Density: NFPA 258 <450
 - 3. Slip Resistance: ASTM D 2047 >0.5
- D. Edging: 1 in. wide, length as required, tapered, maximum thickness same as flooring, solid vinyl, as selected from manufacturer's standard plain colors, as produced by manufacturer of floor tile used, or other manufacturer whose products meet all the Architect's requirements and are approved by them for use on the Project.
- E. Polyurethane based adhesive as recommended by manufacturer.

2.2 WALL BASE

- A. Rubber Wall Base: Provide rubber wall base by Roppe or approved equal by Nora, Armstrong, Forbo or Tarkett conforming to ASTM F 1861, Type TP, and as follows:
 - 1. Height: 4 in. typical.
 - 2. Thickness: 1/8 in. gage.
 - 3. Style: Top-set cove at resilient flooring Style B (Cove). Provide formed corners.
 - 4. Finish: Matte.
 - 5. Roll Lengths: 100 ft. rolls, continuous runs with no pieces less than 10 ft. in any run over 100 ft.
 - 6. Adhesive: Polyurethane based adhesive as recommended by manufacturer.
 - 7. Colors: As indicated on Finish Schedule.

2.3 RESILIENT ACCESSORIES

- A. Provide vinyl termination and transition accessories as supplied by flooring manufacturer for complete installation including caps for cove floor covering, nosing for resilient floor covering and other flooring materials, reducer strip for resilient floor covering and other flooring materials, and transition strips to other materials whether existing or new.
- B. Profile and Dimensions: As indicated and as required to meet accessibility requirements.
- C. Locations: Provide accessories in areas indicated and as required to finish transitions.

- D. Colors and Patterns: As selected by Architect as required to match flooring materials.

2.4 UNDERLAYMENT

- A. Sound Absorbing underlayment: Basis of Design Shaw Groundworks. Provide resilient underlayment composed of polyurethane foam blended with post-consumer granulated rubber tires. 1.9mm thickness.

PART 3 - EXECUTION

3.1 INSPECTION

- A. The Installer shall examine substrates and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Beginning work means Installer accepts substrates and conditions.

3.2 PREPARATION

- A. Manufacturer's Recommendations: Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section.
- B. Clean: Vacuum clean subfloors immediately before installation.
- C. Level: Check subfloor/underlayment tolerances and fill holes, depressions and cracks with leveling compound. Do not scrape, grind, or sand down existing tiles containing asbestos.
- D. Bond Test: Perform bond and moisture tests on concrete subfloors to determine if surfaces are sufficiently cured and dry to receive flooring within the limits specified by flooring manufacturer.
 - 1. Randomly adhere 3 ft. x 3 ft. panels of specified flooring materials spaced about 50 ft. apart throughout areas to receive resilient flooring. Install test panels with adhesives to be used in the actual installation.
 - 2. If panels are securely bonded after 72 hours, installation work may proceed.
 - 3. If panels are not securely bonded, reclean substrates and repeat test until adequate bond is achieved.
- E. Primers: Apply primer prior to application of adhesive if recommended by manufacturer for porous or powdery subfloors.

3.3 INSTALLATION

- A. Manufacturer's Recommendations: Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section.
- B. Color Control: Maintain uniformity of color and pattern; use flooring from same manufactured lots.

- C. Extent: Extend work into closets, toe spaces and similar areas. Provide flooring on covers and other items within floor areas. Cut flooring neatly around fixtures and obstructions. Terminate flooring at the centerline of doors when adjacent finish is dissimilar to avoid seeing dissimilar material when door is closed.
- D. Edges: Provide securely bonded resilient edge strips where indicated and wherever edge of floor would otherwise be exposed.
- E. Lay flooring from room centerlines with grain in same direction. Adhere with full coverage of adhesive observing the manufacturer's recommended trowel notching spreading rates and open times. Roll floor with 150 pound roller to ensure good contact and bond.

3.4 RESILIENT BASE

- A. Base: Adhere base to walls, columns, casework, and all other permanent surfaces and fixtures. Install base in rolls to minimize seams. Tightly bond base to walls without any gaps between wall and base and with 100% coverage of adhesive. Hand roll base to ensure full contact and adhesion. Field form sharp external corners and keep seams and joints as far from external corners as possible. Cut and cope base at internal corners; do not round internal corner with base.
 - 1. Fill top edge of base with sealant where base runs along an irregular wall surface such as masonry. Sealant color shall closely match base color.

3.5 CLEANING AND PROTECTION

- A. Repair minor damage to eliminate all evidence of repair. Clean exposed surfaces using materials and methods recommended by manufacturer of material or product being cleaned. Remove excess adhesives immediately. Remove and replace work that cannot be successfully repaired or cleaned.
- B. Prohibit traffic over newly installed flooring for at least 48 hours. Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protections and reclean as necessary immediately before final acceptance.
- C. Polish and buff floors and base in strict compliance with manufacturer's instructions and recommendations immediately before final acceptance.

END OF SECTION

SECTION 09 72 13

VINYL WALL COVERINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to, vinyl fabric wall coverings and preparation of surfaces.

1.3 RELATED WORK

- A. Carefully examine all of the Contract Documents for requirements which affect the work of this section. Other specifications sections which directly relate to the work of this section include, but are not limited to, the following:
 - 1. Section 09 21 16, GYPSUM BOARD ASSEMBLIES.
 - 2. Section 09 91 00, PAINTING.

1.4 QUALITY ASSURANCE

- A. Installer: A firm which has at least five years experience in work of the type required by this section.
- B. Source: For each type of wall covering required for the work of this section, provide products which are the products of one manufacturer. Provide secondary materials, such as primers and adhesives, which are acceptable to the wall covering manufacturers.
- C. Mock-ups: Before beginning work of this section, provide mock-ups at locations acceptable to Architect and obtain Architect's acceptance of visual qualities. Protect and maintain acceptable mock-ups throughout the work of this section to serve as criteria for acceptance of this work.

1.5 TESTS

- A. Burning Characteristics: Provide materials whose surface burning characteristics, when tested in compliance with ASTM E84 are Class A.

1.6 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation and maintenance

instructions, use limitations and recommendations for each material used. Provide certifications stating that materials comply with requirements.

- B. Initial Selection Samples: Submit samples showing complete range of colors, textures, and finishes available for each wall covering material used.
- C. Verification Samples: Submit representative samples of each wall covering material that is to be exposed in the finished work, showing the full range of color and finish variations expected. Provide samples having minimum area of 144 square inches.
- D. Test Reports: Submit certified reports for tests required.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage.
- B. Sequence deliveries to avoid delay but minimize on-site storage.

1.8 PROJECT CONDITIONS

- A. Environment: Perform work only when temperature and humidity conditions are within the limits established by manufacturers of the materials and products used.
- B. Substrates: Proceed with work only when substrate construction and penetrating work is complete.
- C. Ventilation: Comply with wall covering and adhesive manufacturers' requirements and recommendations.
- D. Lighting: Since lighting conditions can change the appearance of the work, install work only when permanent lighting system is operational and in use.

1.9 COORDINATION

- A. Conference: Convene a pre-installation conference to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

PART 2 - PRODUCTS

2.1 WALL COVERING

- A. Wall Covering Types: Provide the vinyl fabric wallcovering by one of the following meeting the requirements of this section and as indicated in Finish Schedule:
 - 1. MDC Studio Design Solutions

2.2 MATERIALS

A. Vinyl Fabric Wall Covering:

1. Fabric: Woven Poly-Cotton Osnaburg.
2. Product Weight: 20 oz. per lineal yd. (13oz. per sq. yd.) at 54" width
3. Vinyl Weight: 17 oz. per lineal yd.
4. Fabric Weight: 3 oz. per lineal yd.
5. Thickness: 0.017 to 0.027 depending on texture.
6. Digitally Printed Custom Mural

B. Adhesive, primer, sealer, and related items shall be as recommended by wall covering manufacturer, each manufactured expressly for use with the selected wall covering. Materials shall be mildew-resistant and non-staining to the wall covering.

2.3 SPECIFICATIONS / TESTING / CERTIFICATION

A. Federal Specification: CCC-408D, TYPE II

B. NSF/ANSI342 Sustainability Standard - exceeds

C. Fire testing:

ASTM-E84 Tunnel Test: Class A

NFPA 286 Corner Burn Test Class A

NFPA 265 Corner Burn Test Class A

*Meets or exceeds requirements for flame spread, smoke developed and flash over.

PART 3 - EXECUTION

3.1 INSPECTION

A. The Installer shall examine substrates, supports, and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means Installer accepts substrates and conditions.

3.2 PREPARATION

A. Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section.

B. Acclimatize materials by storing unwrapped in rooms to be covered at least 24 hours before installation.

C. Remove wallplates, fixtures, hardware and similar items and replace when work is completed.

- D. Prime and seal substrates in accordance with wall covering manufacturer's recommendations. Provide release coat on all virgin drywall surfaces.
- E. Test substrates with moisture meters to verify that surfaces do not exceed 4% moisture content or other limit prescribed by wall covering manufacturer.

3.3 INSTALLATION

- A. Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section.
- B. Provide full coverage of adhesive on back of wall coverings. Install vertically and truly plumb with seams located more than 6" from corners. Overlap and double cut seams to form tightly matched closures. Roll and brush to remove air bubbles. Trim neatly at penetrations and terminations. Horizontal seams are not permitted.
- C. Remove excess adhesive before it dries by following manufacturer's instructions and recommendations.

3.4 TOLERANCES

- A. Wall covering seams shall be invisible after completion. Free edges of wall coverings and locations where wall coverings abut dissimilar materials shall be neatly trimmed, straight and tight against the dissimilar material or corner.

3.5 CLEANING, REPAIR AND PROTECTION

- A. Repair minor damage to eliminate all evidence of repair. Clean exposed surfaces using materials and methods recommended by manufacturer of material or product being cleaned. Remove and replace work that cannot be successfully cleaned or repaired.
- B. Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protections and reclean as necessary immediately before final acceptance.

END OF SECTION

SECTION 09 77 00

MAGNETIC WALL COVERINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to magnetic dry erase fabric wall coverings and preparation of surfaces.

1.3 RELATED WORK

- A. Carefully examine all of the Contract Documents for requirements which affect the work of this section. Other specifications sections which directly relate to the work of this section include, but are not limited to, the following:
 - 1. Section 09 21 16, GYPSUM BOARD ASSEMBLIES.
 - 2. Section 09 91 00, PAINTING.

1.4 QUALITY ASSURANCE

- A. Installer: A firm which has at least five years experience in work of the type required by this section.
- B. Source: For each type of wall covering required for the work of this section, provide products which are the products of one manufacturer. Provide secondary materials, such as primers and adhesives, which are acceptable to the wall covering manufacturers.
- C. Mock-ups: Before beginning work of this section, provide mock-ups at locations acceptable to Architect and obtain Architect's acceptance of visual qualities. Protect and maintain acceptable mock-ups throughout the work of this section to serve as criteria for acceptance of this work.

1.5 TESTS

- A. Burning Characteristics: Provide materials whose surface burning characteristics, when tested in compliance with ASTM E84 are Class A.

1.6 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation and maintenance instructions, use limitations and recommendations for each material used. Provide certifications stating that materials comply with requirements.
- B. Initial Selection Samples: Submit samples showing complete range of colors, textures, and finishes available for each wall covering material used.
- C. Verification Samples: Submit representative samples of each wall covering material that is to be exposed in the finished work, showing the full range of color and finish variations expected. Provide samples having minimum area of 144 square inches.
- D. Test Reports: Submit certified reports for tests required.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage.
- B. Sequence deliveries to avoid delays, but minimize on-site storage.

1.8 PROJECT CONDITIONS

- A. Environment: Perform work only when temperature and humidity conditions are within the limits established by manufacturers of the materials and products used.
- B. Substrates: Proceed with work only when substrate construction and penetrating work is complete.
- C. Ventilation: Comply with wall covering and adhesive manufacturers' requirements and recommendations.
- D. Lighting: Since lighting conditions can change the appearance of the work, install work only when permanent lighting system is operational and in use.

1.9 COORDINATION

- A. Conference: Convene a pre-installation conference to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

PART 2 - PRODUCTS

2.1 WALL COVERING

- A. Wall Covering Types: Provide the magnetic dry erase fabric wallcovering by one of the

following meeting the requirements of this section and as indicated in Finish Schedule:

1. Visual Magnetics Dry Erase magnetic Wallcovering.
2. Walltalkers Mag Rite 48 writeable, projectable magnetic surface
3. Idea Paint Mag Wallcovering

2.2 MATERIALS

A. Magnetic Dry Erase Fabric Wall Covering:

1. Wall covering shall consist of mildew-resistant fabric coated thin magnet liner below the wall covering's surface and micro-iron coating on the backside. Face shall have a dry erase coverings with a non-ghosting surface.
2. Wall covering shall conform to Class A flame resistance requirements.

B. Adhesive, primer, sealer, and related items shall be as recommended by wall covering manufacturer, each manufactured expressly for use with the selected wall covering. Materials shall be mildew-resistant and non-staining to the wall covering.

2.3 FIRE HAZARD CLASSIFICATION

- A. Provide materials bearing the U.L. label and marking, indicating the fire hazard classification of the wall covering, as determined by ASTM E 84, Tunnel Test.
- B. Materials shall comply with Underwriters' Laboratories Class A, Fire Hazard Classification (Flame Spread 25 max., Fuel Contributed 25 max., and Smoke Developed 25 max.).

PART 3 - EXECUTION

3.1 INSPECTION

- A. The Installer shall examine substrates, supports, and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means Installer accepts substrates and conditions.

3.2 PREPARATION

- A. Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section.
- B. Acclimatize materials by storing unwrapped in rooms to be covered at least 24 hours before installation.
- C. Remove wallplates, fixtures, hardware and similar items and replace when work is completed.
- D. Prime and seal substrates in accordance with wall covering manufacturer's recommendations.

Provide release coat on all virgin drywall surfaces.

- E. Test substrates with moisture meters to verify that surfaces do not exceed 4% moisture content or other limit prescribed by wall covering manufacturer.

3.3 INSTALLATION

- A. Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section.
- B. Provide full coverage of adhesive on back of wall coverings. Install vertically and truly plumb with seams located more than 6" from corners. Overlap and double cut seams to form tightly matched closures. Roll and brush to remove air bubbles. Trim neatly at penetrations and terminations. Horizontal seams are not permitted.
- C. Remove excess adhesive before it dries by following manufacturer's instructions and recommendations.

3.4 TOLERANCES

- A. Wall covering seams shall be invisible after completion. Free edges of wall coverings and locations where wall coverings abut dissimilar materials shall be neatly trimmed, straight and tight against the dissimilar material or corner.

3.5 CLEANING, REPAIR AND PROTECTION

- A. Repair minor damage to eliminate all evidence of repair. Clean exposed surfaces using materials and methods recommended by manufacturer of material or product being cleaned. Remove and replace work that cannot be successfully cleaned or repaired.
- B. Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protections and reclean as necessary immediately before final acceptance.

END OF SECTION

SECTION 09 81 29
SPRAY APPLIED ACOUSTICAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes spray applied acoustic treatment at ceilings.
- B. Related Sections include the following:
 - 1. Divisions 21, 23, and 26 Sections for light fixtures, sprinklers, and air-distribution components.

1.3 DEFINITIONS

- A. LR: Light Reflectance coefficient.
- B. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
 - 1. Joint pattern.
 - 2. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, and access panels.
 - 3. Ceiling perimeter and penetrations through ceiling; trim and moldings.
- C. Samples for Initial Selection: For components with factory-applied color and other decorative finishes.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each wood specialty ceiling.
- E. Research/Evaluation Reports: For ceiling and components and anchor type.
- F. Maintenance Data: For finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Manufacturer must have a current Underwriters Laboratories (UL) Code Evaluation Report.

- B. Manufacturer must be in compliance with the 2015 International Building Code.
- C. Manufacturer must be ISO 9001:2015 Certified.
- D. Applicator: Licensed by manufacturer.
- E. Manufacturer must subscribe to independent laboratory follow-up inspection services of Underwriters Laboratories and Factory Mutual. Each bag shall be labeled accordingly.
- F. Mock-up: Apply a 100 square foot representative sample to be reviewed by the Architect and Owner prior to proceeding.
- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials, system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install spray applied acoustical insulation until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.8 COORDINATION

- A. Coordinate layout and installation with other construction including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 SPRAYED ACOUSTICAL TREATMENT AT CEILINGS

- A. International Cellulose Corporation, K-13 Spray-On-Systems or approved equal.
 1. Bond strength to be greater than 100 psf per ASTM E 736.
 2. Product will be Class 1 Class A per ASTM E 84/ UL 723.
 3. Non-corrosive per ASTM C 739.
 4. Bond Deflection per ASTM E 759: 6" Deflection in 10' Span – No Spalling or Delamination.
 5. R-Value to be 3.75 per inch per ASTM C 518.
 6. Comply with 2015 IBC stability requirements for interior finishes.
 7. Meet ASTM C 1149
 8. Minimum Fiber Recycled Content to be 75%.
 9. Shall not contain any added Urea-Formaldehyde Resins.

10. Material to have been tested in accordance with ASTM E 1042. Testing laboratory must be NVLAP accredited.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing and substrates to which specialty ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of specialty ceilings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide masking, drop cloths or other satisfactory coverings for materials/surfaces that are not to receive insulation to protect from over-spray.
- B. Coordinate installation of the sprayed cellulose fiber with work of other trades.
- C. Prime surfaces as required by manufacturer's instructions or as determined by examination..

3.3 INSTALLATION

- A. General: Install specialty ceilings to comply with manufacturer's recommendations.
- B. Cure insulation with continuous natural or mechanical ventilation.
- C. Remove and dispose of over-spray.

END OF SECTION 09 81 29

SECTION 09 91 00

PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Carefully examine all of the Contract Documents for requirements which affect the work of this section. The exact scope of work of this section cannot be determined without a thorough review of all specification sections and other Contract Documents.

1.2 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to, painting and finishing of all exposed surfaces, both interior and exterior, except the following:
 - 1. Factory finished items, except as noted.
 - 2. Finished metal surfaces of stainless steel, copper, brass, and bronze.
 - 3. Surfaces in concealed areas such as crawl spaces, above ceilings and the like.
 - 4. Moving parts, code required labels, and equipment data plates.
 - 5. Mechanical and electrical items not in public spaces.
 - 6. Acoustical ceiling systems.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, paint analysis, application instructions, use limitations and recommendations for each material used. Provide certifications stating that materials comply with requirements and that paint products used are the highest quality produced by the manufacturer.
- B. Initial Selection Samples: Submit color swatches showing complete range of colors and finishes available for each paint and finish system.
- C. Verification Samples: Before painting mock-ups, submit representative samples of each material that is to be exposed in the finished work, showing the full range of color and finish variations expected. Provide samples having minimum area of 144 square inches.

1.4 INTENT

- A. A major intent of the work of this section is to finish all work in the project that is exposed to view and not located in concealed areas, crawl spaces and the like.

1.5 QUALITY ASSURANCE

- A. Source: For each type of material required for the work of this section, provide primary materials which are the products of one manufacturer. Provide thinners and other secondary materials which are acceptable to the manufacturers of the primary materials.
- B. Mock-ups: Before beginning primary work of this section, provide 100 square feet mock-ups of each color and paint system at locations acceptable to Architect and obtain Architect's acceptance of visual qualities. Protect and maintain acceptable mock-ups throughout the work of this section to serve as criteria for acceptance of this work.

1.6 TESTS

- A. Testing Agency: The Owner may employ an independent testing agency to perform tests, evaluations and certifications. Cooperate and permit samples of materials to be taken as they are used. The Contractor shall pay all costs of tests which show failure to comply with Contract Documents.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturers' instructions and recommendations. Protect from freezing and damage.
- B. Avoid the possibility of fire by removing flammable materials, solvents and spirits from the project site or by storing materials in UL approved fire-resistive cabinets. Keep work area free from flammable waste and soiled rags.
- C. Sequence deliveries to avoid delays, but minimize on-site storage.

1.8 PROJECT CONDITIONS

- A. Weather, Temperature, and Humidity: Perform work only when existing and forecasted conditions are within the limits established by manufacturers of the materials and products used.
 - 1. Indoor Temperature: Maintain minimum interior temperature of 65°F during application and drying of paints and until occupancy of the building.
- B. Substrates: Proceed with work only when substrate construction and penetrating work is complete.
- C. Ventilation: Comply with manufacturer's requirements and recommendations.
- D. Lighting: Since lighting conditions can change the appearance of the work, work only when permanent lighting system is operational and in use.

1.9 SEQUENCING AND SCHEDULING

- A. Conference: Convene a pre-installation conference to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.
- B. Coordinate this work with work specified in other sections. Furnish information on finish materials to be used in the field to ensure that correct prime coats are used in the shop.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Latex and Alkyd Based Paints: Provide products of one of the following manufacturers that meet or exceed specified requirements:
 - 1. Benjamin Moore and Co. (Moore).
 - 2. ICI Dulux Paint Centers (ICI).
 - 3. PPG/Keeler and Long (PPG)
 - 3. Pratt and Lambert Paints (P & L).
 - 5. The Sherwin Williams Company (S-W).
- B. High Performance Paint Coatings: Provide products of one of the following manufacturers that meet or exceed specified requirements:
 - 1. DuPont.
 - 2. Tnemec Company, Inc. (Tnemec).
 - 3. Porter International (Porter).
 - 4. Sherwin Williams (S-W)
- D. Materials used shall be best grade products of their respective kinds. The Painting Schedule is based on products the above named manufacturers. These are specified to establish a standard of quality and kind of material desired. Provide these products, or equals as approved by Architect.
- E. Note: If substitutes are proposed, submit complete schedule showing materials specified and equivalent materials proposed as substitutes. Provide complete manufacturer's product data on proposed materials. Substitutes must be approved by Architect before commitment for materials is made.
- F. Assume full responsibility for proper performance of materials, for method of application, and for compatibility of materials applied over shop coats or other coats previously applied, including but limited to primers, sealers, preservative treatments, etc. Notwithstanding specific schedules in this Section, select primers which have been verified to be appropriate for each of the substrates and finishes encountered.
- G. Provide miscellaneous painting materials such as linseed oil, shellac, turpentine, and thinner of the highest quality.

2.2 COLORS

- A. Provide colors in accordance with schedule provided by Architect. Tint and match colors to the satisfaction of Architect. Provide facilities for comparison and adjustment of colors. No limit is placed on number of colors that may be required; however the following maximum number of colors may be used in any one room, area, or surface:

- 1. Interior: Four colors.

2.3 FILLERS, SOLVENTS, AND MISCELLANEOUS MATERIALS

- A. Turpentine: Pure gum spirits of turpentine conforming to Fed Spec. TT-T-801.
- B. Drier: Conform to Fed. Spec. TT-D-65.
- C. Tinting Materials: Best quality, ground in pure boiled linseed oil, limeproof, and non-fading.

2.1 PRODUCTS

- A. Finishing Materials: Provide finish products and systems as scheduled at the end of this section. Provide secondary products as recommended by manufacturers' of primary products.
 - 1. Colors: Will be selected by Architect; many colors will be used. Match Architect's color chips and numbers. Custom mix colors as directed. Deeptone, bright, and accent colors may be used.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

- A. Inspection: The Applicator shall examine substrates and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means Applicator accepts substrates and conditions.
- B. Responsibility: The Applicator shall be solely responsible for the finishing work and shall prepare substrates as needed to obtain the highest quality finished surfaces.
- C. Manufacturer's Recommendations: Strictly comply with manufacturers' instructions and recommendations, except where more restrictive requirements are specified in this section.
- D. Cleaning: Do not finish over dirt, rust, grease, moisture and other conditions detrimental to formation of a durable finish film. Clean surfaces to remove dirt, oil, grease, mildew, asphalt, concrete splatters, and all other foreign substances.
- E. Removal and Protection: Remove finished hardware, fixtures, accessories, and similar items

or provide adequate protection to ensure that these surfaces are not finished or splattered. Replace these items when finishing work is completed.

- F. Shop Primers: Remove incompatible primers and reprime or provide barrier coats in compliance with finish manufacturer's instructions. Metal to receive spray fireproofing shall not be primed and as noted on drawings.
- G. Masonry and Concrete: Prepare materials by removing laitance, efflorescence, form release agents, and surface glaze by cleaning and washing as recommended by finish manufacturer and approved by Architect. Brush surfaces to remove loose particles. Allow a minimum of 60 to 90 days curing time before finishing poured and precast concrete. Allow a minimum of 30 to 60 days curing time before finishing concrete masonry. Determine substrate alkalinity and moisture content and, if necessary, take appropriate remedial actions as recommended by manufacturers of primary finish materials.
- H. Wood: Prepare wood surfaces by sanding smooth, sealing knots, setting nails and fasteners, and filling holes, cracks, and imperfections with putty acceptable to finish manufacturer. For transparent finished work, use putty and filler color matched to wood to minimize its appearance. Seal and backprime all interior and exterior woodwork immediately after delivery to site and before installation.
- I. Ferrous Metal: Prepare shop primed metal surfaces by solvent wiping, sanding and touching-up shop prime coats. Prepare bare metal surfaces in accordance with Steel Structures Painting Council SP-6. Remove welding flux and splatter, burrs, and all other surface defects and foreign substances. Clean surfaces by washing with water followed by phosphate rinsing. Apply prime coats immediately after completion of cleaning.
- J. Galvanized Metal: Aggressively clean new galvanized surfaces with grease cutting solvent, such as undiluted vinegar, to remove fabricating oils. Touch-up abraded surfaces immediately with zinc-rich paint or rust-inhibiting paint acceptable to the Architect.
- K. Aluminum: Solvent clean surfaces equal to SSPC SP-1. Do not use red lead primers on aluminum surfaces.
- L. Doors: Finish tops, bottoms, and edges of doors the same as door faces.
- M. Drywall: Clean surfaces free from dust and foreign substances. Joint treatment materials shall be thoroughly dry. Paint metal corner beads and trim with metal primer before application of water based finish coatings

3.2 APPLICATION

- A. Manufacturer's Recommendations: Strictly comply with manufacturers' instructions and recommendations, except where more restrictive requirements are specified in this section.
- B. Material Preparation: Mix and prepare materials in strict compliance with manufacturer's recommendations. Do not thin materials without Architect's approval. Keep foreign

substances out of finishing materials.

- C. Primers: Provide primers as recommended by finish system manufacturer for substrates encountered. Tint all primers and undercoats to the approximate shade of the finish coat, making each coat slightly darker and closer to the finished shade. Use deep base primers for deeptone, bright, and accent colors. Prime surfaces immediately after surface preparation to prevent contamination of substrate.
- D. Application: Apply paint and finish systems as scheduled using brushes, rollers, or painter's mitts. Spray application of paint and finish systems is not acceptable for field work, except for variegated paint systems. Apply finish materials at coverage rates and dry film thicknesses recommended by their manufacturers. Provide additional coats as needed to eliminate all show through and bleed through areas.
- E. Extent: Finish all surfaces behind removable items. Finish inside of ducts and grilles with flat black paint when these surfaces are visible. Finish surfaces of access doors, panels and covers that are visible when opened with same finish and color as face panels.
- F. Sanding: Sand before application and between coats as recommended by finish system manufacturer.
- G. Recoat Time: Allow manufacturer's recommended waiting period between successive coats.
- H. Finish Appearance: Provide uniform final finishes, free of runs, sags, wrinkles, streaks, shiners, brush/roller marks, color variations and other imperfections.
- I. Mock-Up Matching: Provide final finishes which exactly match approved mock-ups.

3.3 FIELD QUALITY CONTROL

- A. Testing: The Owner reserves the right to employ an independent testing agency to conduct material evaluation and application tests. The Contractor shall cooperate fully and, when requested, permit samples of materials to be taken from containers as the materials are applied to building surfaces.
- B. Cost of Testing: If tests indicate that materials or work does not comply with requirements, the Contractor shall pay for tests performed, all retesting, and shall remove and replace non-complying work.

3.4 TOUCH-UP, CLEANING, AND PROTECTION

- A. Touch-up damaged coatings and finishes to eliminate evidence of repair.
- B. Clean finished surfaces and remove all finish splatters from adjacent work. Remove and replace work that cannot be successfully cleaned.
- C. Provide signs and temporary protection to ensure work being without damage or

deterioration at time of final acceptance. Remove protections and reclean as necessary immediately before final acceptance.

3.5 PAINT SCHEDULE

- A. Number of coats scheduled is minimum. Refer to Paragraph 3.2D, hereinbefore.
- B. The following finish systems refer to products of Tnemec Co. and Benjamin Moore, unless indicated otherwise. Provide these systems or comparable systems from specified manufacturers.

INTERIOR PAINT SCHEDULE

1. Interior Wood-Painted, Field Applied:
(Semi Gloss Latex System)
Coat 1: Benjamin Moore Super Spec Alkyd Enamel Undercoater and Primer/Sealer (C245)
Coat 2: Benjamin Moore Ultra Spec 500 Acrylic Copolymer Semi Gloss (N539)
Coat 3: Same as Coat 2
2. Interior Drywall:
(Eggshell Latex System)
Coat 1: Benjamin Moore Ultra Spec 500 Interior Latex Primer (N534)
Coat 2: Benjamin Moore Ultra Spec 500 Acrylic Copolymer Eggshell (N538)
Coat 3: Same as Coat 2
Note**: Provide Benjamin Moore Ultra Spec 500 Flat (N536) on ceilings
3. Interior Drywall to Receive Special Coatings - Wet Areas:
(Epoxy System):
Coat 1: Benjamin Moore Super Spec HP Waterborne Polyamide Epoxy Metal Primer (P42-70)
Coat 2: Benjamin Moore Super Spec HP Waterborne Polyamide Epoxy Enamel High Gloss (N42)
Coat 3: Same as Coat 2
4. Interior CMU and Concrete Walls:
(Acrylic Emulsion System)
Coat 1: Benjamin Moore Super Spec Masonry Hi-Build Block Filler (206)
Coat 2: Benjamin Moore Ultra Spec 500 Acrylic Copolymer Eggshell (N538)
Coat 3: Same as Coat 2
5. Interior Concrete and CMU Walls - Wet Areas:
(Epoxy System)
Coat 1: Benjamin Moore Waterborne Epoxy Block Filler (P31)
Coat 2: Benjamin Moore Super Spec HP Waterborne Polyamide Epoxy Enamel High Gloss (N42)
Coat 3: Same as Coat 2

6. Interior Miscellaneous Metal:
(Surface Preparation: SSPC-SP3)
Coat 1: Benjamin Moore Super Spec HP Waterborne Polyamide Epoxy Metal Primer
(P42-70)
Coat 2: Benjamin Moore Super Spec HP Waterborne Polyamide Epoxy Enamel High
Gloss (N42)
Coat 3: Same as Coat 2
7. Mechanical and Electrical Work (Paint all exposed items throughout the project except
factory finished items with factory-applied baked enamel finishes which occur in
mechanical rooms or areas, and excepting chrome or nickel plating, stainless steel, and
aluminum other than mill finished. Paint all exposed ductwork and inner portion of all
ductwork: Same as specified for other interior metals, hereinabove.

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to, the following:
 - 1. Interior panel signs as scheduled at the end of this Section.

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to:
 - 1. Section 06 10 00, Rough Carpentry; blocking.
 - 2. Section 09 91 00, Painting; painting materials and specifications.
 - 3. Section 10 44 13, Fire Extinguishers and Cabinets; "fire extinguisher" signs.
 - 4. Division 26 - Electrical; "Exit" signs; wiring for external sign illumination

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and recommendations for each material used. Provide certifications stating that materials comply with requirements. Manufacturers shall have at least five years experience in the manufacture of sign systems specified.
- B. Shop Drawings: Provide large scale shop drawings for fabrication, installation and erection of all parts of the work. Provide large scale layouts of sign wording, spacing, type size and style. Provide plans, elevations, and details of anchorages, connections and accessory items. Provide installation templates for work installed by others. Provide full size spacing templates for individual letters and numbers.
- C. Initial Selection Samples: Submit samples showing complete range of colors, textures, and finishes available for each material used.
- D. Verification Samples: Submit representative samples of each material that is to be exposed in the finished work, showing the full range of color and finish variations expected. Provide samples having minimum area of 144 square inches or full-size units.

1.5 INTENT

- A. A major intent of the work of this section is to provide colorfast, durable building identification devices as scheduled and as required by codes. Provide all signs and graphics required by authorities having jurisdiction even if not otherwise indicated in the Contract Documents.

1.6 QUALITY ASSURANCE

- A. Source: For each type of material required for the work of this section, provide primary materials which are the products of one manufacturer. Provide secondary materials which are acceptable to the manufacturers of the primary materials.
- B. ADA Requirements: Comply with City of New York requirements and Americans with Disabilities Act requirements, including Type 2 Braille.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage.
- B. Sequence deliveries to avoid delays, but minimize on-site storage.

1.8 SEQUENCING AND SCHEDULING

- A. Delay installation of work of this section until near time of Substantial Completion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Provide products of one of the following manufacturers if they meet or exceed the requirements of these specifications, or approved equal:
 - 1. Andco Industries
 - 2. Cornelius
 - 3. Gemini, Inc.
 - 4. Lynn Sign Company
 - 5. Mohawk Engraving Company
 - 6. The Supersine Company

2.2 MATERIALS AND PRODUCTS

- A. Panel Signs: Aluminum Sheet and Plate: ASTM B 209 (ASTM B 209M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and

with not less than the strength and durability properties of 5005-H15. Fabricate with edges smoothly beveled.

1. Machine engrave letters, numbers, symbols, and other graphic devices into panel sign on face indicated to produce precisely formed copy, incised to uniform depth
2. Tactile and Braille Copy: Manufacturer's standard process for producing copy complying with ADA Accessibility Guidelines and ICC/ANSI A117.1. Text shall be accompanied by Grade 2 braille. Produce precisely formed characters with square cut edges free from burrs and cut marks

2.3 FABRICATION

- A. Fabricate work to be truly straight, plumb, level and square with smooth flat surfaces and sharp corners, except where indicated otherwise.
- B. Precisely form work to sizes, shapes, and profiles indicated on approved shop drawings.
- C. Fabricate metal work with uniform, invisible joints.

PART 3 - EXECUTION

3.1 INSPECTION

- A. The Installer shall examine substrates, supports, and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means Installer accepts substrates and conditions.

3.2 INSTALLATION

- A. Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section.
- B. Install work plumb, level, in true plane and alignment. Provide signs and graphics where shown or scheduled using mounting methods indicated.

3.3 TOLERANCES

- A. The following allowable installed tolerances are allowable variations from locations and dimensions indicated by the Contract Document and shall not be added to allowable tolerances indicated for other work.
 1. Allowable Variation from True Plumb, Level and Line: $\pm 1/8"$ in 10'-0"
 2. Allowable Variation from True Plane of Adjacent Surfaces: $\pm 1/16"$

3.4 ADJUSTING, CLEANING AND PROTECTION

- A. Adjust work to present the best possible appearance. Touch-up damaged finishes and repair damage to eliminate evidence of repair. Clean exposed surfaces using materials and methods recommended by manufacturer of material or product being cleaned. Remove and replace work that cannot be successfully repaired or cleaned.
- B. Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protections and reclean as necessary immediately before final acceptance.

3.5 SIGNAGE AND GRAPHICS SCHEDULE

- A. Schedule to be determined.

END OF SECTION

SECTION 10 44 00

FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to, the following:
 - 1. Fire extinguisher cabinets.
 - 2. Mounting brackets.
 - 3. Fire extinguishers.

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to:
 - 1. Division 21: Fixed fire protection systems, standpipes, valves and hose cabinets.

1.4 SUBMITTALS

- A. Product Data: Submit cabinet manufacturer's product data, installation instructions and recommendations.
- B. Verification Samples: Submit representative samples of each material that is to be exposed in the finished work, showing the full range of color and finish variations expected. Provide samples having minimum area of 144 square inches.

1.5 QUALITY ASSURANCE

- A. Source: For each type of product required for the work of this section, provide products which are the products of one manufacturer.
- B. Provide portable extinguishers which bear the UL listing mark.
- C. Comply with applicable building and fire code regulations of the City of New York.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver products in unopened factory labeled packages. Store and handle in strict compliance

with manufacturers' instructions and recommendations. Protect from damage.

- B. Sequence deliveries to avoid delays, but minimize on-site storage.

PART 2 - PRODUCTS

2.1 HOSE AND VALVE CABINETS

- A. Cabinets: Provide recessed units of proper size to accommodate fire hose and valve. Provide stainless steel door with vertical plate breakable glass and include manufacturer's standard piano hinge, door pull and friction catches or latches.

2.2 EXTINGUISHER CABINETS

- A. Cabinets: Provide recessed units of proper size to accommodate extinguisher. Provide stainless steel door with vertical plate breakable glass and include manufacturer's standard piano hinge, door pull and friction catches or latches.

2.3 MOUNTING BRACKETS

- A. Provide manufacturer's standard bracket designed to prevent accidental dislodgment of extinguisher, of proper size for type and capacity of extinguisher indicated, in manufacturer's standard plated finish.
 - 1. Provide brackets for extinguishers not located in cabinets.
 - 2. Mounting bracket shall be a heavy gage steel bracket with baked enamel finish equal to Larsen's Model Number 862 Fire Extinguisher Bracket.

2.4 FIRE EXTINGUISHERS

- A. General: Provide fire extinguishers for each cabinet and other locations indicated, in colors and finishes selected by Architect from manufacturer's standard, that comply with authorities having jurisdiction.
- B. Multipurpose Dry Chemical Type: UL-rated 4-A:60-B:C, 10-lb nominal capacity, in enameled steel container.

2.5 FABRICATION

- A. Fabricate cabinets to be truly straight, plumb, level and square.
- B. Provide cabinets to sizes, shapes, and profiles indicated on approved shop drawings.
- C. Fabricate cabinets with uniform, tight joints and smoothly finished edges.

2.6 FINISHES

- A. Factory Baked Enamel: For all exposed surfaces visible when cabinet door is closed, provide manufacturer's standard baked-on primer suitable for field finishing. For all cabinet surfaces concealed when door is closed, provide minimum 1. mil dry film thickness of thermosetting acrylic enamel over substrate which has been prepared by inhibited chemical cleaning, conversion coating, and priming. Provide AA C12 C42 R1X.
- B. Hardware: Provide chrome plated exposed door pull or fully concealed pull.

PART 3 - EXECUTION

3.1 INSPECTION

- A. The Installer shall examine substrates, supports, and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means Installer accepts substrates and conditions.

3.2 INSTALLATION

- A. Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section.
- B. Securely install at heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction and the Architect. If exact locations are not indicated, locate where field directed by Architect.
- C. Prepare recesses accurately to neatly accept cabinets. Coordinate with work in other sections to ensure proper sequence, position, height and clearances.

3.3 ADJUSTING, CLEANING, PROTECTION

- A. Adjust operating parts to work easily, smoothly, and correctly.
- B. Repair minor damage to eliminate all evidence of repair. Remove and replace work which cannot be satisfactorily repaired.
- C. Clean exposed surfaces using materials and methods recommended by manufacturer of product being cleaned. Remove and replace work that cannot be successfully cleaned.
- D. Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protections and reclean as necessary immediately before final acceptance.

END OF SECTION

SECTION 10 51 23

LAMINATE CLAD LOCKERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to, the following:
 - 1. Laminate Clad wardrobe lockers indicated as "cubbies".

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to:
 - 1. Section 06 10 00, Rough Carpentry; Blocking and bases for lockers.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, specifications and installation instructions.
- B. Shop Drawings: Provide large scale shop drawings for fabrication, installation and erection of all parts of the work. Provide plans, elevations, and details of anchorages, connections and accessory items. Provide locker numbering sequence information.
- C. Field Measurements: Take accurate field measurements before preparation of shop drawings and fabrication. Do not delay job progress.
- D. Verification Samples: Submit representative samples of both locker sheet metal, showing the full range of color and finish variations expected. Provide samples having minimum area of 144 square inches.

1.5 QUALITY ASSURANCE

- A. Source: Provide lockers which are the products of one manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver lockers in unopened factory labeled cartons. Store and handle in strict compliance

with manufacturer's instructions and recommendations. Protect from damage.

- B. Sequence deliveries to avoid project delays, but minimize on-site storage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design: Hollman Inc., Laminate Lockers

2.2 MATERIALS

- A. General: All core materials shall be fire retardant treated. All laminate materials to be fire retardant.
- B. Locker Frame: Tops, sides, and back shall be constructed of 5/8" high density thermo-fused melamine.
 - 1. Expansion / contraction within +/- 1/16" per locker.
- C. Multi-tier system as indicated on Drawings.
- D. Visible Edges: Sealed with a 1.5 millimeter PVC edge banding to closely match locker doors
- E. Locker Doors:
 - 1. Laminate: 5/8 inch high-industrial grade particle board core with .030 inch vertical grade high pressure Class II-B fire retardant plastic laminate. Matching laminate applied to interior & exterior door face.
 - 2. Door edges sealed with eased edge 1.5 mm PVC edge banding to closely match laminate.
- F. Standard hardware:
 - 1. Number disk, 1-1/2" Dia. flush mounted disc with 3/8" high contrast digits. US Block 1L font.
 - 2. Coat Hook(s), 2-prong metal hooks.
 - 3. Hinges are nickel finished, concealed, heavy duty European steel allowing 110 degree door opening with a limited lifetime warranty.
 - 4. Two hinges per door 35" H & under.
- G. No locks
- H. Venting: 12 millimeter openings between door and top and bottom of locker and dividers on multiple opening frames provide continuous natural air flow.

2.3 FABRICATION

- A. Locker shall be fabricated using doweled and glued & nailed assembly process.

- B. Fabricate lockers square, rigid and without warp, with the finished faces flat and free of scratches and chips.
- C. Machine all parts and attachment holes accurately and without chips..
- D. Case Edge: All exposed edges of locker frame including shelves are edge banded with plastic laminate matching exterior finish.
- E. Venting: Locker tops, bottoms, and shelves are held back 1/8" to allows adequate natural air flow. Vent holes located in the rear panel and shelves.
- F. Number Plates: An inlaid flush mounted 1-1/2" diameter antique brass with black numbers.
- G. Panels: Exposed to view, locker end and filler panels in matching laminate with lockers and exposed fascia.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section. Provide lockers at locations shown. Install lockers plumb, level and in accurate alignment. Beginning work means Installer accepts substrates and conditions.
- B. Space fasteners at not more than 48" on center. Conceal fasteners as much as possible. Install base, flat tops, and filler panels. Provide trim, fillers and other accessories as necessary to provide a complete, uniform assembly.

3.2 ADJUSTING, CLEANING AND PROTECTION

- A. Adjust operating parts to work easily, smoothly, and correctly. Touch-up damaged coatings and finishes to eliminate evidence of repair. Repair minor damage to eliminate all evidence of repair. Clean exposed surfaces using materials and methods recommended by manufacturer of material or product being cleaned. Remove and replace work that cannot be successfully cleaned or repaired.

END OF SECTION

SECTION 10 56 13

METAL STORAGE SHELVING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. Metal shelving systems.

1.3 RELATED SECTIONS

- A. Section 06 10 00 - Rough Carpentry.
- B. Section 09 22 16 - Gypsum Board Assemblies

1.4 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 2. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 - 3. ASTM A1008 - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
 - 4. ASTM E488 - Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements.

1.5 SUBMITTALS

- A. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Rated capacities, construction details, material descriptions, dimensions of individual components, profiles, and finishes.
 - 3. Delivery, storage, handling, and installation instructions and recommendations.
 - 4. Assembly and installation instructions.
 - 5. Maintenance instructions and recommendations.
- B. Shop Drawings: Project-specific drawings indicating details of storage specialties layout and installation, including:
 - 1. Show components, assemblies, connections, attachments, and anchorage.
 - 2. Show fabrication and installation details. Distinguish between factory and field work.
 - 3. Include clearances, spacing, and relation to adjacent construction in plan, elevation, and section, details, attachments and work by others.

4. Show trim and accessories.
 5. Indicate seismic bracing and fastening requirements.
- C. Closeout Submittals:
1. Operation and Maintenance Data: For adjusting, repairing and replacing components and accessories.
 2. Warranty: Submit manufacturer's sample warranty.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain storage specialties through one source from a single approved manufacturer.
- B. Manufacturer Qualifications: Minimum 5 years experience in manufacture of similar products in use in similar environments, including project size, and complexity, and with the production capacity to meet the construction and installation schedule.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's original unopened containers with manufacturer's labels attached.
- B. Do not deliver components until spaces to receive them are clean, dry, and ready for their installation. Ship to jobsite only after roughing-in, painting and other finishing work has been completed, installation areas are ready to accept work.
- C. Handle and install materials to avoid damage.

1.8 WARRANTY

- A. Special Warranty: Manufacturer's written warranty to repair or replace components that fail in materials or workmanship. Failures include the following:
1. Fracturing or breaking components including panels, shelves, or hardware resulting from normal wear and tear and use other than vandalism.
 2. Collapse or failure of metal grid locker components not resulting from overloading or vandalism.
 3. Faulty operation of hardware and accessories.
- B. Storage Unit Warranty Period: 10 years.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Penco, U-Line or approved equal. Equivalent products by other manufacturers may also be considered subject to compliance with requirements and approval of the Architect.

2.2 METAL SHELVING SYSTEMS

- A. Basis of Design: Heavy Duty Boltless Steel Shelving System as manufactured by Uline.

- B. All shelving shall comply with SMA and ANSI MH 28.1.
- C. Posts: All posts shall be punched for clip or nut and bolt construction.
 - 1. Anchors and Fasteners:
 - a. Factory Provided: Material, type, and size recommended by manufacturer for secure anchorage to substrate.
 - b. Field Installed: Manufacturer-recommended fasteners furnished by Contractor as required for locker substrate and project requirements.
- D. Shelves and accessories are to be vertically adjustable on 1-1/2" centers.
- E. Side sway braces or side panels to be attached to the side flange of the post. Bolts, nuts, and sway braces or panels shall not obstruct the full adjustability of the shelves.
- F. Box Post: Box post to be roll formed and have overall dimensions of 3/4" wide x 2-7/16" deep. Box post to be flush within 1/4" of the face of the shelves when assembled. 14 gauge minimum
- G. Offset Angle: Offset angle post shall be roll formed and have overall dimensions of 1-1/8" wide x 2-1/2" deep. The rear flange shall be punched to accept sway braces or backs, the side flange shall be punched to accept side sway braces or side panels.
- H. Side Panels: Shall be 24 gauge steel. Each side shall be punched with holes for bolting to posts.
- I. Sway Braces: To be 12 gauge x 3/4" steel punched at each end for bolting to posts and at the center for strength and ease of assembly.
- J. Shelf Clip: One piece rugged compression type to insert into either box or offset angle posts to form a positive four point connection. Clips shall have two claw-like hooks to seat firmly into post slots and two tabs at bottom to seat into post holes for a tight friction connection. All clips for all posts and shelves to be the same. Design shall offer a pre-clipping feature to simplify erection. All shelves are to have four independently adjustable clips.
- K. Shelves: Conventional Flange, 16 gauge steel with a 1-3/16" vertical face on all four sides, front and rear faces to have 17/32" return flange 90o with the edges coined upward to prevent snagging. Sides to have a 5/8" return flange 90o. All four shelf corners shall be closed by lapping and spot welding together to provide a firm, rigid shelf. Shelf shall be universally punched for use with all available accessories and for clip or bolted assembly.
- L. Ledge Tops: To be manufactured from 14 gauge steel and furnished to give ledge top a finished appearance.
- M. Base Strip: Shall be 18 gauge steel attached to face of shelf with bolts and nuts to close space between the bottom of the shelf and the floor.
- N. Finish: Finish to be selected from manufacturer's standard colors. Surface to be pretreated with a multiple stage cleaning and metal preparation process. Finish coat of high grade pure polyester powder coat is applied and properly cured to paint manufacturer specifications to achieve optimum performance.

- O. Metal Shelving Fabrication:
 - 1. Fabricate components square, and rigid. Make exposed metal safe to touch and free of sharp ends or burrs.
 - 2. Form frames, panels, doors, and accessories from one-piece, or one rigid assembly, unless specifically shown on Shop Drawings.
 - 3. Factory preassemble metal components by welding all joints, and connections; with no bolts, nuts, screws, or rivets used in assembly, except as required for knock down shipping and attachment to mounting surfaces.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine installation areas and mounting surfaces with Installer present, for compliance with manufacturer's installation tolerances including required clearances, floor level, location of blocking and anchoring reinforcements, and other existing conditions that may affect installation or performance.
- B. Proceed with installation only after correction of unsatisfactory conditions.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install components plumb, level, and true; using integral levelers and anchors in accordance with manufacturer's recommendations, shop drawings and other approved submittals.
- B. Metal Shelving Requirements:
 - 1. Anchor uprights to walls using anchors of type, size, and spacing recommended by manufacturer.
 - 2. Install shelves in each unit.
 - 3. Adjust metal shelving so connectors and other components engage accurately and securely. Verify modular components fit easily into alternate locations without force or use of tools.
- C. Install seismic fastening in accordance with approved shop drawings.
- D. Fasten components to adjacent construction through back, near top and bottom. Fasten at indicated height using fasteners recommended by manufacturer. Comply with mounting height requirements for accessible components.
- E. Through-bolt adjacent units using connector bolts provided by manufacturer.
- F. Install hardware uniformly and precisely without binding.
 - 1. Adjust and align hardware so moving parts operate freely and contact points meet accurately.

2. Allow for final adjustment after installation to ensure hardware operates smoothly without warping or binding and closes with uniform reveals.

3.4 CLEANING AND PROTECTION

- A. Repair or replace defective work as directed by Architect upon inspection.
- B. Clean surfaces. Touch up marred finishes, or replace damaged components that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by manufacturer.
- C. Turn over operation and maintenance instructions to Owner. Instruct the Owner's personnel upon request.
- D. Protect installed products from damage, abuse, dust, dirt, stain, or paint until completion of project. Do not permit use during construction.

END OF SECTION

SECTION 11 68 00
PLAYGROUND EQUIPMENT

PART 1 - GENERAL

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

1.2. WORK INCLUDED

- A. The Contractor shall furnish all playground equipment and transportation to the site as located, described and set forth in the contract plans, specifications and details. This includes new playground equipment as well as salvaged play equipment to be reinstalled at the Midland Elementary School.
- B. The Contractor shall furnish all labor, materials, equipment and transportation required to install/assemble all play equipment as located, described and set forth in the contract plans, specifications and details and in accordance with manufacturer's requirements and recommendations, and as specified herein.

1.3. RELATED SECTIONS

- A. SECTION 31 23 00 EARTHWORK.
- B. SECTION 32 12 16 ASPHALT CONCRETE PAVING.
- C. SECTION 32 13 13 PORTLAND CEMENT CONCRETE PAVEMENT.
- D. SECTION 32 18 00 RUBBER SAFETY SURFACING.

1.4 REFERENCE STANDARDS AND SPECIFICATIONS

- A. Playground equipment design, layout, and installation shall comply with the following standards and guidelines as applicable.
 - 1. CPSC - Consumer Product Safety Commission Guidelines for Playground Safety, latest edition.
 - 2. ASTM - American Society for Testing and Materials, Designation: F 1487, Standard Consumer Safety Performance Specification for Playground Equipment for Public Use, latest edition.
 - 3. ANSI - American National Standards Institute.
 - 4. AASHTO - American Association of State Highway and Transportation Officials (tests of specifications).

- B. Requirements not specifically set forth herein, but required by the agencies listed in above shall be understood to be a requirement of this contract since these standards of quality and safety are established as the industry standard(s). Any conflicts between the agency standards and the contract documents shall be brought to the attention of the Owner's Representative, and unless otherwise directed in writing, the agency standards shall be the minimum requirement to be followed.

1.5 SHOP DRAWINGS

- A. Salvaged Playground Equipment - Prior to disassembling the play equipment (to be salvaged and reinstalled) as required by the Contract Documents, the following shall be submitted to the Owner's Representative for review and approval:
 - i. Shop drawings showing all important details of construction and dimensions showing the equipment, arrangement, footing spacing and lengths. Shop drawings shall stipulate and certify to compliance with all CPSC and ASTM standards and guidelines as applicable.
- B. New Playground Equipment - Prior to ordering, furnishing and/or installing the play equipment as required by the Contract Documents, the following shall be submitted to the Owner's Representative for review and approval:
 - i. Certified product data, shop and fabrication drawings showing all important details of construction and dimensions showing the equipment, arrangement, footing spacing and lengths. Shop drawings shall stipulate and certify to compliance with all CPSC and ASTM standards and guidelines as applicable.
 - ii. Descriptive literature and technical specifications for all play equipment installations.
 - iii. Warranty certificates for all applicable play equipment features, components, hardware, finishes and other applicable items.
 - iv. In the event that it is impossible to conform to certain details of this specification due to differing manufacturing techniques or conventions, submit complete summary of all non-compliant components or elements.
- C. Warranty: All operating parts, structural elements and safety surface shall be guaranteed against failure or defect during normal use and operation for the entire warranty period as established by the manufacturer.
- D. Guarantee Period: Safety surfacing shall be free of defect due to workmanship or material for a minimum of one (1) year from date of acceptance. Any defective elements shall be replaced in part or whole by the Contractor at no cost to the Owner. See Specification for Safety Surfacing.

1.6 SAMPLES

- A. Submit the following samples in accordance with the provisions of the GENERAL CONDITIONS.
 - 1. Submit samples and descriptive literature of all items specified in this Section, including treatments, finishes, colors, and test information.

1.7 QUALIFICATIONS

- A. Installer shall have a minimum of five (5) years experience with a minimum of fifteen (15) playground installations. References will be required.
- B. **Contractor is responsible for securing a Certified Playground Safety Inspector to ensure ASTM and SPSC compliance. A certificate of compliance will be issued to the Owner prior to final inspection.**

1.8 RELATED DOCUMENTS

- A. Reference the manufacturer's plans, details, specifications and related product information.

PART 2 - MATERIALS

2.1 PLAY EQUIPMENT

- A. Play equipment shall be manufactured by Kompan, Inc. as represented by Local Principal Sales Representative, Kompan, Inc., 1.845.868.2023, or approved equal. Play equipment shall be as follows:

Quantity	Model Number	Description
1	PCM310614	Triple Mega Deck
1	KPL123	Wheelchair Carousel
2	ELE400024	Spinner Bowl

- B. Colors to be determined by owner.

2.2 RESILIENT SAFETY SURFACE

- A. The resilient safety surface shall meet the requirements as specified in Section 32 18 00 of the Specifications.

2.3 CAST IN PLACE CONCRETE

- A. Concrete for the footings will be cast in place cement concrete as specified in Section 03 30 00 of the Specifications. Top of concrete footings shall be twelve (12) inches minimum below finished grade.

2.4 MAINTENANCE KIT

- A. The Contractor shall provide the Owner with a maintenance kit that is to include twenty (20) replacement hardware covers / caps for each play structure, any special tools required for replacement of parts, one (1) gallon of graffiti removal / cleaning solutions as recommended by the manufacturer, one (1) gallon of touch-up paint for each color of painted metal, a manual that includes all installation and maintenance instruction provided by the manufacturer.
- B. The Contractor shall provide 10 spare pieces of each type of hardware / fastener used on the structure and the appropriate tools delivered to a location to be determined by the Owner.

2.5 EDGING

- A. Refer to contract drawings for edging locations and details.

PART 3 - EXECUTION

- 3.1 The Contractor shall assemble the specified equipment under the supervision of an approved Supervisor according to the manufacturer's instructions, the contract drawings and these Specifications.
- 3.2 The Contractor shall locate the structures to the lines and grades specified in the drawings in these Specifications and according to the specifications of the manufacturer of the equipment. Adjust all equipment to suit site gradients; no sloping platforms, tracks, or members intended to be horizontal shall be accepted.
- 3.3 The excavation for the footings shall be done according to the Contract Drawing details and per the manufacturer's recommendations.
- 3.4 The equipment shall be located and brought to the heights as shown in the drawings and as recommended by the manufacturer with vertical and horizontal members set plumb and then braced to be held in place.
- 3.5 The concrete shall be poured around the supporting pieces of the equipment to the grades detailed. The concrete shall be poured and cured according to Section 03 30 00 of these Specifications. Slope tops of footings to drain; set bottom of vertical members into gravel base to ensure drainage; do not encase bottom in concrete.
- 3.6 After the specified cure period of the concrete has passed the bracing may be removed.
- 3.7 The fills and surfaces shall then be placed and brought to the grades shown in the Contract Drawings and in accordance with Section 31 22 13 of these Specifications.
- 3.8 Contractor is responsible for a complete and safe playground installation, complying with all stated standards. If damage occurs to any piece of play equipment (salvaged or new), Contractor shall submit, in writing, a proposed correction for review and approval by Owner and Owner's Representative. Acceptable corrections can range from painting scratched surfaces – to replacement of equipment – at no additional cost to the Owner.

PART 4 GUARANTEE AND ACCEPTANCE/LIABILITY

- 4.1 All operating parts and structural elements of the play equipment and safety surface shall be guaranteed against failure or defect during normal use and operation for the entire warrantee period as established by the manufacturer.
- 4.2 Any defective elements shall be replaced in part or whole by the Contractor at no cost to the Owner.
- 4.3 The Contractor and the manufacturer shall hold the Owner and Owner's Representative harmless from any and all damages or liability resulting from negligent acts and omissions on the part of the Contractor or manufacturer, or resulting from defective parts, or improperly assembled equipment. Contractor shall provide secure storage for all equipment on job site.
- 4.4 The Contractor is responsible for securing a Certified Playground Safety Inspector to ensure ASTM and SPSC compliance. A certificate of compliance will be issued to the Owner prior to final inspection.

END OF SECTION 116800

SECTION 12 20 00

WINDOW TREATMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this section.

1.2 DESCRIPTION OF WORK

- A. Furnish and install roller window shades and related items as shown on Drawings and as specified. Refer to Drawings for sizes, quantities, and locations.

1.3 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to:
 - 1. Section 05 50 00, Metal Fabrications, Miscellaneous supports.
 - 2. Section 06 10 00, Rough Carpentry; Blocking.
 - 3. Section 08 51 00, Aluminum Windows

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, installation instructions, use limitations and maintenance and cleaning recommendations for each product used. Provide certifications stating that materials comply with requirements.
- B. Shop Drawings: Provide large scale shop drawings for fabrication, installation and erection of all parts of the work. Provide plans, elevations, and details of anchorages, connections and accessory items, and wiring diagrams. Provide detailed sections of head, jamb and sill conditions. Provide installation templates for work installed by others.
- C. Field Measurements: Where possible, take accurate field measurements before preparation of shop drawings and fabrication. Do not delay job progress; allow for field cutting and fitting.
- D. Initial Selection Samples: Submit samples showing complete range of colors and finishes available for each material used.
- E. Verification Samples: Submit representative samples of each material that is to be exposed in the finished work, showing the full range of color and finish variations expected. Provide one complete small window shade unit finished as specified in colors selected by Architect.

1.5 INTENT

- A. A major intent of the work of this section is to provide window shades for all windows and to provide proper clearances between shades and windows to prevent heat build-up which could damage windows.

1.6 QUALITY ASSURANCE

- A. Source: Provide window shades which are complete, functional assemblies produced by one manufacturer for the entire project. Provide secondary materials which are acceptable to the manufacturer of the primary products.
- B. Mock-ups: Before beginning primary work of this section, provide mock-ups at locations acceptable to Architect and obtain Architect's acceptance of visual qualities . Protect and maintain acceptable mock-ups throughout the work of this section to serve as criteria for acceptance of this work. Acceptable mock-ups may be incorporated into the finished work.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and products in unopened factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from damage.
- B. Sequence deliveries to avoid delays, but minimize on-site storage.

1.8 SEQUENCING AND SCHEDULING

- A. Conference: Convene a pre-installation conference to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.
- B. Delay installation of shade units until near time of Substantial Completion of Project.

1.9 WARRANTY

- A. Provide shade manufacturer's lifetime warranty on all hardware components. Provide 5 year warranty on fabrics.

1.10 EXTRA MATERIAL

- A. Provide packaged, wrapped and labeled maintenance stock equal to 2% of the actual quantity of shade units installed.

PART 2 - PRODUCTS

2.1 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:

1. Hunter Douglas Architectural Window Coverings
2. Kirsch.
3. Levolor Corp.
4. Louverdrape, Inc.

2.2 ROLLER SHADE OPERATORS

- A. DUAL ROLLER SHADES: Universal mount steel brackets with 2 separate solar and room darkening blackout roller shades operating independently of each other.
- B. ROLLER TUBE: Circular-shaped aluminum tube extruded from alloy and temper 6063 T-6. Extruded tube to have a .063" wall thickness (2.5" outside diameter to have a 0.79" wall thickness). Heavily reinforced with minimum of six internal ribs and flutes providing additional tensile strength and allows for secure placement of clutch and end plug.
- C. SPRING-LOADED IDLE END: Reinforced idler assembly containing spring loaded end plug with positive locking wheel allowing for up to 7/8" adjustment and provides for a secure installation and removal of shade. Locking tube bearing plug contains minimum 6 ribs and flutes and inserted a minimum of 2 3/8" into roller tube on heavy duty systems.
- D. CLUTCH OPERATED: Chain-driven operator capable of lifting up to 20 pounds of weight with a maximum allowable pull force of 10 pounds. Utilization of adjustment-free continuous qualified T304 stainless ball chain with 110 lbs. breaking strength for precise control, smooth operation, and ensures a uniform look. Components must be maintenance-free from adjustments or lubrication for trouble-free lifetime operation.
 1. 90 pound breaking strength chains will not be accepted.
 2. Chain anchor device to be compliant with WCMA safety standard A100.1.1-2010 and must prevent the clutch system from moving the roller shade through lowering and raising if not properly installed as specified in ANSI Standard Section 6.5.2.
- E. BOTTOM BAR: Industry standard sealed hembar with weight sewn into pocket providing for tracking adjustments and uniform look of the hanging fabric panel. Flat Fabric Wrapped Hembar.
- F. MOUNTING HARDWARE: Manufacturer's standard or heavy duty bracket constructed of hardened 1/8" thick steel to support full weight of shade with bracket and screw hole covers to provide uniform look. Locking mechanism on bracket adapter provides for a secure installation and removal of the shade.
- G. CEILING-RECESSED POCKET: Extruded aluminum alloy U-shaped housing for recessed mounting in acoustical tile or drywall ceilings. 9" for Dual Shades x 5.25" profile with removable bottom aluminum closure. Ceiling-recessed pockets include an integrated tile support.

2.3 SHADE FABRIC

- A. General: Inherently anti-static, flame retardant, fade and stain resistant, light filtering, room darkening fabric. Comply with NFPA 701.

- B. Fabric 1: SheerWeave 7000, PVC-free polyester with acrylic backing. Color Canyon.
- C. Fabric 2: E Screen 7503 Mermet PVC Coated Fiberglass textiles. Color Peal/White.

2.3 FABRICATION

- A. Fabricate work to be truly straight, plumb, level and square and to completely fill window openings from jamb-to-jamb and sill-to-head.
- B. Provide work to sizes, shapes, and profiles indicated on approved shop drawings. Provide units fabricated from non-fading, non-staining materials which do not required lubrication for the life of the installation.
- C. Fabricate work with uniform, tight joints and with ends of units occurring only over window mullions.

PART 3 - EXECUTION

3.1 INSPECTION

- A. The Installer shall examine substrates, supports, and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning work means Installer accepts substrates and conditions.

3.2 INSTALLATION

- A. Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this section.
- B. Securely install units plumb and level at proper height and relationship to surrounding work.

3.3 ADJUSTING, CLEANING, PROTECTION

- A. Adjust operating parts to work easily, smoothly, and correctly.
- B. Touch-up damaged coatings and finishes to eliminate evidence of repair.
- C. Repair minor damage to eliminate all evidence of repair. Remove and replace work which cannot be satisfactorily repaired.
- D. Clean exposed surfaces using materials and methods recommended by manufacturer of material or product being cleaned. Remove and replace work that cannot be successfully cleaned.
- E. Provide temporary protection to ensure work being without damage or deterioration at time

of final acceptance. Remove protections and reclean as necessary immediately before final acceptance.

3.4 DEMONSTRATION

- A. Demonstrate equipment and instruct Owner's personnel in routine maintenance and proper operation procedures.

END OF SECTION

SECTION 12 32 13

MANUFACTURED CASEWORK

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. All of the Contract Documents, including General and Supplementary Conditions and Division 1 General Requirements, apply to the work of this section.

1.2 DESCRIPTION OF WORK

- A. The work of this section includes, but is not limited to, interior architectural woodwork including the following:

1. Plastic laminate and transparent finish casework and countertops.
2. Solid surface countertops.

1.3 RELATED WORK

- A. Coordinate the work of this Section with work provided under separate contracts for general construction and building services. Examine Contract Documents for requirements that affect the work of this Section. Other Specification Sections under separate contract that relate directly to work of this Section include, but are not limited to:
 1. Section 01 43 39, Mock-Ups; Requirements for mock-ups.
 2. Section 05 50 00, Metal Fabrications; counter supports.
 3. Section 06 10 00, Rough Carpentry; blocking, grounds and nailers.
 4. Division 22 - Plumbing; coordination with plumbing requirements.
 5. Division 26 - Electrical; coordination with electrical requirements.

1.4 SUBMITTALS

- A. **Certifications:** Provide certifications stating that materials and fabrication complies with specification requirements.
- B. **Shop Drawings:** Provide large scale shop drawings for fabrication, installation and erection of all parts of the work. Provide large scale detailed plans, elevations, and details of anchorages, connections and accessory items. Indicate required blocking locations and clearances.
- C. Provide full size templates for units bound by partitions or other architectural features on more than two sides to ensure adequate clearance is maintained for installation. Provide templates for sinks, fittings and fixtures to be fit into casework and countertops.
- D. **Field Measurements:** Take accurate field measurements before preparation of shop drawings and fabrication. Do not delay job progress; allow for field cutting and fitting where taking

field measurements before fabrication is not possible.

- E. Verification Samples: Submit at least two fully finished representative samples minimum 12 by 12 inches in size of each material that is to be exposed in the finished work, showing the full range of color and finish variations expected.

1.5 QUALITY ASSURANCE

- A. Source: For each material type required for work of this Section, provide primary materials which are product of one manufacturer. Provide secondary or accessory materials which are acceptable to manufacturers of primary materials.
- B. Installer: A firm with a minimum of three years experience in type of work required by this Section.
- C. Quality Standard: Provide work complying with applicable requirements of AWI Quality Standards. Where not otherwise indicated, fabricator may choose among options permitted by AWI for grade of work specified.

- 1. Panel Products: All panel products shall be Baltic Birch plywood.

- D. Mock-Ups: Prior to commencing the primary work of this Section, provide mock-up of architectural woodwork items at locations acceptable to Architect. Obtain Architect's acceptance of visual qualities. Protect and maintain accepted mock-ups throughout the remainder of the work of this Section to serve as criteria for acceptance of the work. Approved mock-ups may be incorporated in the finish work. Provide the following:

- 1. Section of countertop.
 - 2. Typical section of casework.
 - 3. Wood base.

1.6 PROJECT CONDITIONS

- A. Substrates: Proceed with work only when substrate construction and penetration work is complete.
- B. Wet Work: Proceed with work of this Section after wet work has been complete and fully dry or cured. Wet work is defined as plaster, gypsum drywall, paint, concrete, etc.
- C. Conditioning: Advise general construction contractor of temperature and humidity requirements for woodwork installation. Do not install work of this Section until required temperature and relative humidity in areas of installation has been stabilized and will be maintained.

PART 2 - PRODUCTS

2.1 MANUFACTURER/FABRICATOR

- A. Basis of Design: Casework as designed is based on products of Milder Office, Philadelphia, PA with production facilities in New York and Pennsylvania. Equivalent products may be considered subject to approval of the Architect.

2.2 VENEERS AND LUMBER

- A. Quality Standard: Provide AWI Premium Grade materials and workmanship.
- B. Veneers and Lumber: Provide AWI Lumber Grade 1 and AWI Grade A Veneer, book-matched, minimum 6" face veneer width. Match adjacent pieces for color and grain pattern.
 - 1. Species: Unless otherwise indicated on Drawings, Finnish or Baltic Birch, "S - Select", Plain-sliced, Grades SBB, BBB or better. Single clean face. No patches, no repairs, and no splits shall be permitted. Only moderate pin knots are permitted.
 - 2. The compressive, tensile, bending and shear strength as well as the bearing face of plywood shall meet the requirements of SFS 2417 (birch) standards.
- C. The amount of formaldehyde released by a panel as determined according to DIN 52368 shall be no more than 0.1 mg HCHO/h.m2. EI=3.5mg HCHO/h.m2. (This conforms with Class E1 requirements.)
- D. All exposed faces and edges to be sanded smooth and clear finished. Manufacturer's standard clear UV resistant coating. Finish surface shall have a minimum taber abraser rating of 250.

2.3 PLASTIC LAMINATE

- A. Plastic Laminate Manufacturers: Provide plastic laminate materials that meet or exceed specified requirements from one of the following manufacturers, or Architect approved equals:
 - 1. Formica Decorative Laminates; Formica Corporation, Cincinnati, OH 45241.
 - 2. Nevamar Decorative Laminates; Nevamar Corporation; Odenton, MD 21113.
 - 3. Wilsonart Decorative Laminates., Ralph Wilson Plastics Co.; Temple, TX 76501.
- B. Provide laminate complying with NEMA LD 3, and the following:
 - 1. Horizontal and Vertical Surfaces (Except Postformed Surfaces): General Purpose Standard Grade, GP-50 (0.50 in. nominal thickness).
 - 2. Postformed Surfaces: Postforming Type, PF-42 (0.42 in. nominal thickness).
 - 3. Balance Sheet: Backer Type, BK-20 (0.20 in. nominal thickness).
 - 4. Color/Texture/Pattern: selected by Architect.
 - 5. Laminate Cladding Grade - Exposed Surfaces:
 - a. Horizontal Surfaces: Grade HGS
 - b. Postformed Surfaces: Grade HGP.
 - c. Vertical Surfaces: Grade HGS
 - d. Edges: Grade HGS

- e. Pattern Direction: As indicated
- 6. Materials for Semiexposed Surfaces:
 - a. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
 - b. Drawer Sides and Backs: Solid-hardwood lumber
 - c. Drawer Bottoms: Hardwood plywood.

2.4 ALUMINUM COMPONENTS

- A. All aluminum components shall be of alloy 6463-T6.
- B. All components shall be free from extrusion and milling marks. All components shall be clear anodized to a low lustre.
- C. All aluminum uprights and legs shall be 1-1/16" or 1-3/8" o.d. brushed with 180 grade abrasive and acid etched prior to anodizing.
- D. Wall thickness of aluminum pipe shall be 1/8"
- E. Aluminum supports shall be internally threaded to a depth of 1-1/8" deep at both ends of each tube, thread pitch of 12NF.
- F. All legs shall be supplied with levelers i n the same finish and alloy as the legs with full 1" adjustability.

2.5 CASEWORK

- A. Quality Standard: Provide AWI Premium Grade materials and workmanship.
- B. Wood Species and Cuts: Hard Maple (Acer saccharum) "Select White" (sapwood), Plain-sliced, Grade FAS (1) or better.
- C. Plastic Laminate: Provide as specified above:
 - 1. Color/Texture/Pattern: as selected by Architect.
 - 2. Construction: Provide balancing sheets for work. Fabricate work for use in wet environments. All surfaces of core shall be covered with laminate. Provide loose splashes with six sides covered with laminate. All exposed surfaces shall be covered with "face" laminate.
- D. Door Frames: Reveal overlay, to profiles indicated on the Drawings. Coordinate with hardware requirements.
- E. Dust Panels: Provide plywood dust panels in work.
- F. Preparation for Related Work: Prepare for electrical, telephone, mechanical, and plumbing work. Cut holes to fit templates of appliances and fixtures. Trim openings so that core

materials are covered with laminate.

- G. Hardware: The Milder Furniture System is designed for disassembly, allowing products to be easily moved, stored, or for a damaged part to be replaced (instead of the whole unit), to easily level units, and to hinge panels and doors.
1. Pipe Hinge: Proprietary pipe-hinge offers a seamless solution with no visible hardware connections on the product interior or door. 1.065"O diameter brushed clear anodized aluminum pipe is incorporated into casework construction as a structural element and hinge. Sections of pipe are fastened to case good structure and door. The pipe sections pivot on the Milder custom nylon bushing connectors that fit into the pipe sections' inner diameter. The bottom segment of the pipe supports the casework with an integrated Milder threaded leveler.
 2. L-Clip: Laser-cut bent metal stainless steel bracket that provides more structural support under vertical load than conventional L-Clips. Clips are fastened to plywood parts with M4 machine screws and threaded inserts to allow for repeated assembly and disassembly.
 3. Mending Plates: laser-cut stainless steel plate used to connect casework and work surfaces from below. Plates are designed to fit in pockets machined on the underside of plywood parts. Milder mending plates have radiused corners that correspond to fit machined pockets and are flush with the wood surface when installed. Plates are fastened to plywood parts with M4 machine screws and threaded inserts to allow for repeated assembly and disassembly.
 4. Disk + Bolt Detail: Connection detail that used to secure plywood parts and 1.065" diameter pipe in the top of casework and work surfaces. The connection is made with a truss head machine screw that sits in a pocket machined into the plywood part. The screw pulls the top tightly to the structure below by threading into a press-fitting located in the pipe. A machined aluminum disc sits in a machined shoulder above the screw to conceal the connecting hardware. Installed disk is flush with the horizontal surface.
 5. Milder Custom Grey Swivel Stem Caster (Locking and non-locking): Custom produced for Milder Furniture, the caster is based on products engineered for the medical equipment market. Custom 'Milder Grey' compliments milder product and aluminum tubing. Work surfaces and storage units accept 4.84" casters for barrier-free mobility.
 - 4 x 7/8 Grey TPR Wheel with ball bearing mount
 - 3/8 x 1-1/2" Threaded stem
 - 4.84" load height (123mm)
 - 4.19" Swivel radius (107mm)
 - 160 lbs capacity.
- H. Integrated Electrical/Communications Receptacles and Outlets: Provide manufacturer's standard system of receptacles, cabling, wiring and devices for distribution of power and communications within furniture and casework items as indicated on the Drawings. All items shall be modular type, comply with electrical code and be UL listed as applicable. Distribution shall terminate at a junction box in the base to allow infeed connection by Electrical Contractor.
- I. Casework Joinery: Fabricate countertops to have fewest possible seams. Locate seams where shown on shop Drawings as approved by Architect. Do not use any exposed fasteners

or connectors. Use concealed bolts to hold seams and joints hairline, lightproof tight.

2.6 SOLID SURFACE COUNTERTOPS

- A. Solid Surfacing Manufacturer: Provide solid surfacing materials that meet or exceed specified requirements from the following manufacturer, or Architect approved equals:
 - 1. "Corian", by DuPont
 - 2. "Swanstone" by Swan Corp.
 - 3. "Glacial Quartz" by InPro Corp.
- B. Solid Surfacing Material: Homogeneous solid sheets of filled plastic acrylic resin complying with the material and performance requirements of ANSI Z124.3, Type 6, and Fed. Spec. WW-P-541E/GEN, without a precoated finish.

2.7 SHOP FINISHING

- A. Interior Architectural Woodwork and Doors for Satin Transparent Finish Where Indicated (all hardwoods and hardwood veneers): Manufacturer's standard clear finish, AWI Premium Grade, UV protective coating.

2.9 INSTALLATION MATERIALS

- A. Blocking, Shims, and Nailers: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.
- B. Screws: Select material, type, size, and finish required for each use, nonferrous metal or hot-dip galvanized, unless otherwise indicated. Comply with ASME B18.6.1 for applicable requirements.
- C. Nails: Stainless-steel nails, type, size, and finish required for each use. Comply with FS FF-N-105..
- D. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous metal or hot-dip galvanized anchors and inserts, unless otherwise indicated. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors.

PART 3 - EXECUTION

3.1 WORKMANSHIP - GENERAL

- A. Work of this Section shall conform to design and detail indicated. Where practicable, work shall be finished and assembled at architectural millwork shop.
- B. Work shall be finished smooth and free from machine or tool marks that will telescope through finish.

3.2 INSTALLATION

- A. Preinstallation Meeting: Convene conference to establish procedures to maintain optimum working conditions and coordinate with related work. Require woodwork manufacturer, Installer, Contractor, and Architect to attend.
- B. The Installer shall examine substrates, supports, and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected.
- C. Condition woodwork to average prevailing humidity conditions in installation areas prior to installation.
- D. Proceed with installation only when required ambient conditions have been properly maintained, as determined by all attending pre-installation conference.
 - 1. Provide work to sizes, shapes, and profiles indicated on approved shop drawings.
 - 2. Install work to comply with quality standards and tolerances specified for shop work.
 - 3. Color match wood at joints and seams to minimize expression of joints and seams in transparent finished work.
- E. Install architectural woodwork plumb, level, true and straight. Shim as required using concealed shims. Install work, including tops, to a tolerance of $\pm 1/8$ in. in 8 ft.
- F. Scribe and cut architectural woodwork to fit adjoining work. Refinish cut surfaces.
- G. Anchor casework securely in place.

3.3 REPAIRING AND PROTECTION

- A. Repair minor damage to eliminate all evidence of repair. Remove and replace work which cannot be satisfactorily repaired.
- B. Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protections and reclean as necessary immediately before final acceptance.

END OF SECTION

SECTION 220100

GENERAL CONDITIONS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section.

1.1 GENERAL CONDITIONS

- A. Before submitting a proposal, Bidders shall examine all Drawings related to this work and shall become fully informed as to the extent and character of the work required and its relation to the other work in the building.
- B. Before commencing work, the Contractor will examine all conditions of the project upon which his work is in any way dependent for perfect workmanship according to the intent of this Specification. No "waiver of responsibility" for incomplete, inadequate or defective adjoining work will be considered unless notice has been filed by this Contractor and acceded to by the Owner's representative in writing before the Contractor begins any part of the work.
- C. The Contractor will pay for all licenses, permits and inspection fees required by civil authorities having jurisdiction. Comply with all laws, ordinances, regulations, fire underwriters requirements applicable to work herein specified without additional expense to the Owner. (Also local building code requirements.).
- D. It is specifically intended that anything (whether material or labor) which is usually furnished as a part of such equipment as is hereinafter called for (and which is necessary for the completion and proper operation) shall be furnished as part of this Contract without additional cost the Owner, whether or not shown in detail on the Drawings or described in the Specifications.
- E. When Drawings and Specifications conflict or there is a question as to the proper intent of this Contract, the Contractor shall assume the more expensive method in his pricing. All questions shall be directed to the Architect/Engineer in writing only and only up to ten (10) days prior to bidding.
- F. The Drawings indicate the general runs of the piping, ductwork, etc. systems and the location of equipment and apparatus, but it shall be understood that the right is reserved by the Architect/Engineer to change the location of piping work, ductwork, equipment and apparatus to a reasonable extent as building conditions may dictate, prior to their installation without extra cost to the Owner.
- G. Small scale drilling through walls and floors which may contain asbestos shall be performed by a person with a "restricted asbestos handler allied trades certificate" and shall have a copy of it in his possession at all times while working on the project.

- H. Any changes from the Drawings and Specifications and any interpretation thereof shall have the prior approval of the Architect/Engineer. The Contractor shall submit in writing, at the time of signing the Contract, any items of necessary labor and materials, which, in his opinion, are lacking in requirements of the Drawings and Specifications to insure a complete job in all respects. No consideration will be granted to alleged misunderstanding of materials to be furnished, work to be done, or conditions to be complied with, it being understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying Drawings.

END OF SECTION 220100

SECTION 220125

SCOPE OF WORK

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section.

1.1 SCOPE OF WORK

- A. The work under this section includes all labor, materials, equipment, tools, transportation, cutting and patching, excavation and backfill and the performance of all work necessary and required for the furnishing and installation complete of all Plumbing and Drainage work as shown on Contract Drawings, as specified herein and as otherwise required by job conditions or reasonably implied, including but not necessarily limited to the following:
1. Provide complete new and altered sanitary, storm and vent piping from all new plumbing fixtures connecting to existing sanitary and vent system.
 2. Provide complete new and altered hot and cold water piping to all new plumbing fixtures, equipment, etc. as indicated.
 3. Provide all new plumbing fixtures where indicated, complete including traps, stops, drains, strainers, tailpieces, faucets, escutcheons, etc.
 4. Provide complete new piping and final connections to equipment furnished under other Divisions.
 5. Provide all demolition, removal disconnecting, capping, sealing of all existing plumbing piping, apparatus, equipment, fixtures, specialties, accessories, etc. which are not included or incorporated in the new layout.
 6. Provide all required temporary connections to maintain all plumbing services without interruption.
 7. Pipe insulation.
 8. Tests and adjustments.
 9. This Contractor shall obtain all permits, bonds, approvals, etc. at no additional cost to the Owner.
 10. This Contractor shall provide shop drawings for all plumbing fixtures, piping, valves, insulation, equipment, etc.
 11. Furnish minimum 18" x 18" access doors for all valves, cleanouts, etc. in all inaccessible walls, ceilings, etc. Installation by General Contractor.

- 12. Cutting and Patching: See Front End Specifications for Trade Responsibilities.
 - 13. Excavation and Backfill: See Front End Specifications for Trade Responsibilities.
 - 14. Fire stopping per FM/UL and NFPA. Refer to Division 1.
- B. Coordination Drawings: Attention is directed to Division 1 for coordination drawing requirements for this project. These drawings are critical to the proper execution of the work and failure to honor these requirements may become the basis for denial of any and all claims for either or both "time" and "money".
- 1.2 ALTERATION WORK
- A. All equipment, piping, plumbing, fixtures, etc. to be removed, shall be disposed of or salvaged as directed by the Owner. They shall not be removed from the premises without Owners approval.
 - B. All piping to be removed shall be properly plugged or capped so that upon completion of all new work, all abandoned piping shall be concealed in finished areas.
 - C. No dead ends shall be left on any piping upon completion of job.
 - D. The existing systems shall be left in perfect working order upon completion of all new work.
 - E. Location and sizes of existing piping are approximate. Exact sizes and locations of all existing piping shall be verified on the job.
 - F. All removals shall be removed from the site.

END OF SECTION 220125

SECTION 220130

WATER SUPPLY SYSTEM

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

- A. Furnish and install a complete cold-water distribution system to supply water to all new fixtures, water consuming equipment, and valved outlets for the use of other trades and connect to existing piping.
- B. The water supply system shall be complete with all pipe, fittings, valves, mains, risers, branches, shock absorbers, air chambers, hangers, anchors, expansion loops, connections to existing piping, covering, tests, etc. all as shown on the Drawings, as hereinafter specified.
- C. Furnish and install a complete hot water distribution system to supply water to all new fixtures and equipment requiring heated water.

PART 2 - PRODUCTS

2.1 PIPING, FITTINGS AND MATERIALS

- A. All components of water supply system shall confirm to all "No Lead" requirements including NSF/ANSI-372.
- B. The domestic water systems shall be of the following material and shall be in accordance with the latest ASTM and ASME Standards.
- C. Domestic water piping within the buildings shall be seamless drawn or extruded tubing type "L" copper. Both shall be of Chase, Anaconda, Revere, and approved equal, hard temper ASTM B88 with solder joint sweat end fittings. Fittings for use with copper tubing shall be cast brass of Muellers "Streamlin" pattern or approved equal.
- D. Joints for copper tubing shall be made with 95-5 (lead and antimony free) solder. Flanges where required shall be cast brass. Provide dielectric adapters between ferrous and non-ferrous pipe joints.

2.2 VALVES

- A. All shut-off valves 2" and smaller shall be ball valves equal to Apollo 70 Series or Milwaukee BA100 Series Valve. Bronze body with chrome plated trim

- B. This Contractor shall furnish all valves as indicated on the Drawings, or as may be required for the proper control of the pipe lines installed under this Specification, so that any fixture, line or piece of apparatus may be cut out for repair without interference or interruption of the service to the rest of the Facility.
- C. All domestic water valves shall have a minimum working pressure of 125 psig, steam rated unless otherwise noted on the Drawings or specified herein. All valves shall be of one manufacture as manufactured by Milwaukee Valve or Hammond.
- D. All gate valves within the buildings shall be wedge gauge valves with painted iron wheel handles, shall have gland followers in stuffing boxes, and shall be so constructed that they may be repacked while open and under pressure. All valves shall have the name of the manufacturer and working pressure cast or stamped thereon.
- E. All gate valves shall be all bronze with sweat or screwed joint ends as required by the piping system in which they are installed.
- F. Globe valves shall be of all bronze with composition disc, threaded or sweat joint ends as required by piping system in which they are installed.
- G. Check valves shall be all bronze swing check type with threaded or sweat joint ends. Check valves 4 inch and larger shall be iron body bronze mountings and shall be provided with screwed or flanged joint ends as required by piping system in which they are installed.
- H. Drain valves, at risers and at low points, shall be 3/4 inch heavy cast brass with composition washers with male thread for hose connections.

2.3 SHOCK ABSORBERS

- A. Shock absorbers shall be similar and equal to J.R. Smith 5000 series or Zurn Z1700 series with stainless steel pressurized shell sized in accordance with P.D.I. Bulletin WH-201.
- B. Provide shock absorbers on all fixtures and equipment having quick closing valves whether or not indicated on the Drawings.
- C. Provide access doors where shock absorbers are concealed.

2.4 VACUUM BREAKERS

- A. Provide vacuum breakers on water supply piping to each fixture and equipment with submerged inlets, and on faucets and outlets, within the facility to which hose can be, or is attached forming a submerged inlet.
- B. Set vacuum breakers in exposed readily accessible locations at least four inches above floor rim level of fixture, or high point of equipment.
- C. Vacuum breakers shall be chrome-plated brass. "Watts" or other approved.

- D. Vacuum breakers under constant pressure shall be of the continuous pressure type No. 9 "Watts" or Wilkins BFP-8CH or approved equal.

2.5 EXPANSION JOINTS, ANCHORS AND GUIDES

- A. The entire piping installation shall be installed with adequate provision for expansion. No rigid connections will be permitted. Refer to Drawings for locations of expansion joints and related guides and anchors. The joints, guides and anchors shall be as manufactured by Flexonics Products, Metraflex or Flex-weld.
- B. Branches shall be of sufficient length and have three elbow swings to allow for pipe expansion.
- C. Any breaks in the piping within the guarantee period due to improper provision for expansion must be replaced at the expense of this Contractor, and the conditions corrected to prevent future recurrence.
- D. Any damages to surrounding areas and equipment due to this failure shall also be repaired and paid for at the expense of this Contractor.
- E. Joints to have 150 psi rating, ANSI-B16.5 with liner and cover.

2.6 STERILIZATION

- A. The entire domestic water piping system shall be thoroughly sterilized with chlorine before acceptance for domestic operation.
- B. The amount of chlorine applied shall be such as to provide a dosage of not less than 50 parts per million for 24 hours or 200 p.p.m. for one hour. The chlorinating material shall be either liquid chlorine or sodium hypochlorite solution and shall be introduced into the system and drawn to all points of the system. If possible to do so, the lines shall be thoroughly flushed before introduction of the chlorinating material. After a contact period of not less than 24 hours, the system shall be flushed with clean water until the residual content is not greater than 0.2 parts per million. All valves in the lines being sterilized shall be opened and closed several times during the contact period.
- C. Sterilization and tests for purity of water in the entire piping system shall be performed by the Contractor through an approved independent testing laboratory and a certificate shall be furnished to the Architect certifying the quality of purity.
- D. Per ANSI/AWWA Standard C651-05.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. It is the intent that each part of the plumbing system shall be complete in all details and water lines provided with all control valves as indicated on Drawings, or as may be required for the proper control of the pipe lines under this Specification so that any fixture, line or piece of apparatus may be cut out for repair without interference or interruption of the service to the rest of the facility.
- B. This Contractor shall examine carefully the Architectural Drawings in detail and familiarize himself with all conditions relative to the installation of piping, particularly where same is concealed behind furring or in hung ceilings.
- C. In no case shall this Contractor permit his pipes to be exposed beyond finished walls or ceilings unless specifically shown on Drawings. He shall consult with the Contractors of other trades in the building and install his piping in such a way as to least interfere with the installation of other trades.
- D. The water piping shall all be installed so as to drain to a valve provided by this Contractor and branches shall not be trapped but shall have continuous pitch. Where necessary to raise or lower mains, the same shall be provided with a drip and shall be properly valved.
- E. Piping shall be installed, whether indicated or not, so as to rise and/or drop to clear any and all conduits, lighting fixtures, ductwork and heating mains to maintain the desired clear heights. This Contractor shall consult with the Contractors of other trades and facilitate the erection of the equipment and piping.
- F. Run piping straight and as direct as possible, in general forming right angles with or parallel to walls or other piping. Risers shall be erected plumb and true.
- G. After cutting, all pipes shall be reamed out to full bore and before erection the inside of all pipes shall be thoroughly cleaned.
- H. No piping or work shall be concealed or covered until all required tests have been satisfactorily completed and work has been approved by the Architect.
- I. All materials shall be new and installed in a first class manner.
- J. In erecting pipe, friction wrenches and vises shall be used exclusively, and any pipe cut, dented or otherwise damaged shall be replaced by this Contractor.
- K. All ferrous to non-ferrous pipe connections shall be made with approved dielectric pipe or flange unions isolating joints to prevent any electrolytic action between dissimilar materials.

- L. Any piece of pipe 6 inches in length or less shall be considered a nipple. All nipples with unthreaded portion 1-1/2 inch and less shall be of weight corresponding to fitting connected. Only shoulder nipples shall be used, close nipples will not be accepted.
- M. Revised water service shall be in accordance with the local water supply department requirements. All water lines are to be protected from freezing. Install new piping for water service below frost line and provide concrete separations when crossing other utilities. Provide concrete thrust mass at changes of pipe direction conforming to authorities having jurisdiction.

END OF SECTION 220130

SECTION 220160

SANITARY AND STORM DRAINAGE SYSTEMS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

- A. The work under this section includes all labor, materials, equipment and appliances necessary and required to completely install all drainage systems as required by the Drawings; code and as specified herein, including but not limited to the following:
- B. Complete sanitary drainage and venting systems including connections to the existing sanitary drainage and venting systems.
- C. Piping and final connections for equipment furnished under other Divisions.
- D. Alterations and removals to existing sanitary and vent systems.
- E. Tests.

PART 2 - PRODUCTS

2.1 PIPING AND FITTING MATERIALS

- A. All indoor underground storm soil, waste and vent piping shall be service weight cast iron with fittings of bell and spigot type. All exterior underground storm soil and waste piping shall be extra heavy cast iron. Each length shall have the size, weight per foot and the manufacturer's name clearly cast or stamped thereon. Fittings and traps shall be similarly marked and of corresponding weights.
- B. All aboveground storm, soil, waste and vent piping and fittings 3" and larger shall be service weight and fittings of bell and spigot type as specified in paragraph above. Above ground waste and vent piping 2" and smaller shall be galvanized steel, fittings on waste piping shall be galvanized cast iron, recessed drainage pattern, fitting on vent piping shall be galvanized cast iron, beaded pattern, screwed joints shall be made up to be perfectly tight without the use of lead or filler of any kind, except oil or graphite. Nipples for galvanized pipe shall be shoulder type. No close nipples shall be permitted.
- C. Joints shall be made with compression gaskets conforming to the International Plumbing Code (IPC 705.4.2. See 2.1, E. for aboveground joint options where permitted.
- D. All galvanized pipe and fittings shall be galvanized with prime western spelter by hot drip process.

- E. The Contractor has the option of using the following types of joints with hubless cast iron pipe only if approved by the governing agencies. These joints shall be used throughout the project. No mixing of joints shall be permitted.
1. Neoprene gasketed joints similar to Ty-Seal (for above and underground application).
 2. Hubless cast iron pipe with neoprene gaskets and stainless steel clamps (by Clamp-All or equal) above ground only. All in accordance with Cast Iron Soil and Pipe Institute Standard 301 latest edition. Hangers and supports shall be in accordance with manufacturer's recommendations.
 3. Copper DWV system with 50-50 tin antimony solder, DWV with solvent welded or screwed joints meeting CS-270-65.

2.2 CLEANOUTS

- A. Provide easily accessible cleanouts where indicated at base of vertical stacks at ends of horizontal drainage lines and at intervals not exceeding 50 ft.; at each change of direction; on handholes of running traps, and where necessary to make entire drainage system accessible for rodding. Provide at least 18" clearance to permit access to cleanout plugs.
- B. Cleanouts for cast iron pipe shall consist of tarpped extra heavy cast iron ferrule caulked into cast iron fittings and extra heavy brass tapered screw plug with solid hexagonal unit. Cleanouts for wrought iron pipe shall consist of extra heavy brass screw plug in drainage fitting.
- C. Cleanouts turning out through walls and up through floors shall be made by long sweep ells or "Y" and 1/8 bends with plugs and face or deck plates to conform to Architectural finish in the room. Where no definite finish is indicated on the Architectural and/or Mechanical Drawings, wall plates shall be chrome plated cast brass and floor plates shall be nickel bronze.
- D. Cleanouts shall be full size at the pipe up to 6" inclusive. On larger size piping 6" size plugs shall be used.
- E. Cleanout fittings in vertical stacks shall consist of tapped tees capable of receiving a rough brass raised head cleanout plug, J.R. Smith S-4730, Zurn Z1445-A-BP or approved equal.
- F. All cleanout plugs shall be brass lubricated with graphite before installation.
- G. Cleanouts occurring in cast iron soil pipe above floor at change of direction of pipe run and at ends of horizontal runs shall be J.R. Smith S-4425, Zurn Z1441-A-BP or approved equal with cast iron ferrule for caulk connection and fitted with a straight threaded tapered bronze plug with raised hex head.

- H. Cleanout deck plates for finished areas shall be similar and equal to J.R. Smith 4020 series, Zurn ZB1400-X or approved equal with cast iron ferrule, scoriated cutoff sections, brass cleanout plus collar with brass bolts for waterproofed slabs. In tile floor areas the cleanout deck plates shall be recessed to tile.

2.3 FLASHING

- A. Provide 6 lb. lead flashing extending at least 10" beyond edge of all floor drains and vents through roof and all floor sleeves in floors with waterproofing or vapor barriers. Flashing shall be held securely in by clamping devices.
- B. All floor drains shall be provided with flashing rings and 24" square 6 lb. sheet lead flashing, properly flashed into flashing ring of the drain.

2.4 SANITARY DRAINAGE

- A. A complete system of drainage shall be provided as shown on the Drawings. The system shall include all drains, leaders, branches, house drains with all pipe fittings, hangers, anchors, etc. to make a complete sanitary drainage system. The systems shall extend through house drains and terminate as indicated on the Drawings.
- B. Piping shall be sizes as indicated on the Drawings. The sanitary drains shall have a pitch of 1/8" per ft. minimum unless otherwise noted. Branch connections to stacks and house drains shall pitch a minimum of 1/8" per ft.

2.5 PIPING AND FITTINGS

- A. Provide piping of one of the following materials, of weight/class indicated. Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING

- A. The size of soil, waste and vent piping shall be as determined by the State codes, rules and regulations for plumbing and drainage, except where specifically noted to be larger by the Specifications or Drawings and all fixed rules of installation, as set forth in the codes, rules and regulations, shall be followed as part of the Specifications.
- B. This Contractor shall carefully examine the Architectural plans in detail and familiarize himself with all conditions relative to the installation of piping, particularly where same is concealed behind furring or in hung ceilings.
- C. In no case shall this Contractor permit his pipes to be exposed beyond finished plaster lines unless specifically shown on Drawings. He shall consult with the Contractors of other trades in the building and install his piping in such a way as to least interfere with the installation of other trades.

- D. Piping shall be installed, whether indicated or not, so to rise and/or drop to clear any and all conduits, lighting fixtures, ductwork and heating mains to maintain the desired cleat heights. This Contractor shall consult with the Contractors of other trades and facilitate the erection of the equipment and piping.
- E. Run piping straight and as direct as possible in general forming right angles with or parallel to walls or other piping. Risers and stacks shall be erected plumb and true. After cutting, all pipes shall be reamed out to full bore and before erection the inside of all pipes shall be thoroughly cleaned.
- F. No piping or work shall be concealed or covered until all required tests have been satisfactorily completed and work had been approved by the Architect and all other authorities having jurisdiction.
- G. Branch connections shall be made with "Wye" and long "Tee-Wye" fittings, short 1/4 bends, common offsets and double hubs will not be permitted. Short "Tee-Wye" fittings are to be used in vertical piping only. All fittings shall conform to code requirements.
- H. Cleanouts shall be provided at foot of all stacks, at changes of directions, at the ends of branch runs where shown and as required by code, and shall be terminated as described under cleanouts.
- I. The house drains must be run at a minimum grade of 1/8" per ft. downward in the direction of flow. Wherever possible, a 1/4" per ft. pitch shall be maintained. Branch connections to stacks from fixtures shall pitch 1/4" per ft. where possible. Attention is again called to the necessity of maintaining the ceiling heights established.
- J. Furnish and install complete systems of vent pipes from the various plumbing fixtures and other equipment to which drainage connections are made. Vent pipes shall be connected to the discharge of each trap and shall be carried to a point above the ultimate overflow level of the fixture before connecting with any other vent pipe; in general, this will be approximately 3'-6" above the finished floor. Branches shall be arranged to pitch back to fixtures.
- K. The individual vent pipes shall be collected together in branch vent lines and connected to existing vent connections through roof.
- L. Any existing vents through roof, damaged, or if flashing on roof comes loose while connecting new vent to them shall be repaired and reflashed to the roof as required to maintain waterproofing the satisfaction of the Architect.

END OF SECTION 220160

SECTION 220300

PLUMBING FIXTURES AND EQUIPMENT

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

- A. The work under this section shall consist of furnishing all labor, materials, equipment and appliances necessary and required to completely do all plumbing fixture work, as required by the Drawings and as specified herein, including but not limited to the following: plumbing fixtures, traps, fittings, trimmings, brackets, plates, anchor, chair carriers and supports.
- B. Just before the Owner's taking over the work in the building, this Contractor shall thoroughly clean all fixtures furnished and set under this Contract, leaving every fixture in perfect condition and ready for use.
- C. Submit shop drawings and roughing sheets for all equipment for checking and approval.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES AND EQUIPMENT

- A. All fixtures shall be free from imperfections, true as to line angles, curves and color, smooth, watertight, complete in every respect and practically noiseless in operation, Fixtures specified are given as the typical standard required as manufactured by American Standard and they or other similar approved fixtures as made by Kohler or Eljer Companies shall be furnished, set and connected in good substantial, neat workmanlike manner.
- B. The letter designations hereinafter correspond with the schedule on the Drawings.
 - 1. Electric Water Cooler Bottle Filling Station Only - Type A (Handicapped)
Elkay EZH20 Bottle Filling Station Model EZ8WSSSMC.
 - 2. Single Bowl Enameled Cast Iron Sink - Type B2
Kohler model no. K-8689-5U (Color per Architect), with Chicago Faucet 50-E2805-5ABCP with polished finish.
 - 3. Countertop Stainless Steel Sink - Type C
'Just' Model SL-2019-16-GR 16 gauge stainless steel drop in, Chicago faucet W8D-GN2AE1-369 ABCP, 8" centers, 5-1/4" Gooseneck, All required trim.

4. Wall Hydrants (Exterior): J.R. Smith Fig. No. 5509 Qt. or approved equal. Non-freeze, cast brass, exposed, 3/4" straight nozzle, hose outlet, brass casing, solder inlet, key operated, length as required.
5. Roof Drains: JR Smith model 1011, stamper receiver, cast iron domes, cast iron clamping rings, 5" high stainless steel screens factory mounted on clamping rings. Refer to roof detail sheet for drain details. Zurn or Josam equals only.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All fixtures shown on Drawings shall be set, connected and tested by the Contractor. He shall also make all water; soil, waste, vent and other service connections to fixtures as shown on Drawings or as directed and shall set, furnish, connect and test all necessary fittings.
- B. All pipes at fixtures passing into walls, floors or partitions shall be provided with heavy cast brass escutcheons and security (tamperproof) set screws finished to match the pipe. No "waiving" of this section will be permitted.
- C. All fittings escutcheons, faucets, traps, exposed piping etc. shall be brass, chrome plated over nickel plate with polished finish. Any visible hanger nuts shall be security (tamperproof) type and shall likewise be chrome plated over nickel plate.
- D. This Contractor shall be responsible for protecting all plumbing fixtures including in these Specifications against injury from the building materials, tools and equipment. Any fixtures damaged during the construction period shall be replaced new. After all fixtures are set, this Contractor shall carefully grout all around fixtures.

END OF SECTION 220300

SECTION 220420

SUPPORTS, SLEEVES AND PLATES

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

- A. This Contractor shall furnish and install all plates, hangers and supports for his piping.
- B. All piping shall be hung or supported from structural members only.

PART 2 - PRODUCTS

2.1 PIPING

- A. All piping shall be supported from building structure in a neat and workmanlike manner wherever possible, parallel runs of horizontal piping shall be grouped together on trapeze hangers. Vertical risers shall be supported at each floor line with steel pipe clamps. Use of wire perforated metal to support pipes will not be permitted. Hanging pipes from other pipes will not be permitted.
- B. Necessary structural members, hangers and supports of approved design to keep piping in proper alignment and prevent transmission of injurious thrusts and vibrations shall be furnished and installed. In all cases where hangers, brackets, etc., are supported from concrete construction, care shall be taken not to weaken concrete or penetrate waterproofing.
- C. All hangers and supports shall be capable of screw adjustment after piping is erected. Hangers supporting piping expanding into loops, bends and offsets shall be secured to the building structure in such a manner that horizontal adjustment perpendicular to the run of piping supported may be made to accommodate displacement due to expansion. All such hangers shall be finally adjusted, both in the vertical and horizontal direction, when the supported piping is hot.
- D. Pipe hangers shall be as manufactured by Grinnell, whose catalog numbers are given herein, or equivalent Carpenter and Paterson, or F&S Mfg. Co.
- E. Piping shall be supported as follows unless otherwise indicated on the Drawings:
 - 1. Piping: 1-1/2 inch and smaller Fig. #260 adjustable clevis hanger. 2 inch and larger Fig. #174 one-rod swivel roll hanger.
 - 2. Two-rod hangers shall be used for piping close to the ceiling slab or where conditions prohibit use of other hanger types.

3. Anchors for hanger rods shall be Phillips "Red Head" self-drilling type. Anchors shall be placed only in vertical surfaces.
 4. Spacing of pipe supports shall not exceed 6 feet for pipes up to 1-1/2 inch and 10 feet on all other piping.
 5. Hangers shall pass around insulation and a 16 gauge steel protective band; 12 inch long shall be inserted between hangers and insulation.
 6. All piping shall be supported to allow free movement where expanding or contracting. Pipe shall be anchored as required or directed.
 7. All lateral runs of piping shall be securely supported on hangers, rolls, brackets, etc. and in a manner to allow for proper expansion and elimination of vibration.
 8. 2 inch and smaller pipe, where run on walls, shall be supported on wrought iron "J" hook brackets with anchor bolts.
 9. All horizontal pipe, where run overhead or on walls, shall be supported as follows unless otherwise indicated: On adjustable steel clevis type hangers suspended on hanger rods, pipe sizes up to and including 4 inch.
- F. Space limitations in hung ceilings spaces and conditions in other locations may require use of other type of hangers than those specified above. Suitable and approved pipe hangers shall be provided for such job conditions.
- G. All supports shall be fastened to structural members or additional steel supports furnished by this Contractor.
- H. Hanger rods shall be steel, threaded with nuts and lock nuts, sizes in accordance with following schedule:

<u>Pipe Size</u>	<u>Rod Size</u>
3/4" to 2" inclusive	3/8"
2-1/2" and 3" inclusive	1/2"
4" and 5" inclusive	5/8"
6"	3/4"
8" to 12" inclusive	7/8"

- I. Cast iron piping shall be supported at intervals of not more than (5) feet (at each hub) on straight runs.

PART 3 - EXECUTION

3.1 PIPING

- A. Where pipes pass through masonry, concrete walls, foundations, or floors, this Contractor shall set sleeves as are necessary for passage of pipes. These sleeves shall be of sufficient size to permit insulation where required to be provided around pipe passing through. This Contractor shall be responsible for exact location of these sleeves.
- B. Sleeves shall not be used in any portion of building where use of same would impair strength or construction features of the building. Inserts for supporting lateral pipes and equipment shall be placed and secured to form work, and all sleeves inserts locations shall be thoroughly checked with Architect so as not to conflict with other trades.
- C. Where pipes pass through floor or walls, they shall be provided with chromium plated escutcheons.
- D. Anchor horizontal piping where indicated and wherever necessary to localize expansion or prevent undue strain on branches. Anchors shall be heavy forged construction entirely separate from supports.
- E. Anchor vertical piping wherever indicated and wherever necessary to prevent undue strains on offsets and branches. Anchors, unless otherwise noted shall be heavy steel clamps securely bolted and welded to pipes. Extension ends shall bear on building construction.
- F. Auxiliary steel supports that may be required for all mechanical equipment shall be furnished and installed by this Contractor.
- G. All operating equipment including pumps, piping, etc. shall be supported so as to produce minimum amount of noise transmission.

END OF SECTION 220420

SECTION 220430

INSULATION

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

- A. The work under this section shall consist of furnishing all labor, materials, equipment and appliances necessary and required to completely do all insulation work as required by the Drawings and as specified herein including but not limited to the following: Insulation, covering, bands, tie wire.

PART 2 - PRODUCTS

2.1 INSULATION

- A. The materials as specified have been selected from the catalogs of Owens-Corning Fiberglass Corp. and Johns-Manville Sales Corporation and are representative of the quality, design and finish desired. Insulation as manufactured by Gustin Bacon Co., or other approved manufacturer may be submitted for approval provided the product meets fully in all respects (such as density, moisture absorption, alkalinity, thermal-conductivity, jackets) to the materials as delineated below.
- B. All insulation shall be UL rated non-combustible type classified flame spread-25, smoke-developed-50.

2.2 PIPING, FITTINGS AND VALVES

- A. All insulation thickness shall be in accordance with the latest edition of the New York State Energy Conservation Construction Code.
- B. Minimum pipe insulation shall be:
 - 1. Hot water piping up to 1-1/4" - 1" insulation and piping 1-1/2" and larger - 1-1/2" insulation.
 - 2. Cold water piping up to 1-1/2" - 1/2" insulation and piping 1-1/2" and larger - 1" insulation.
- C. Domestic cold, hot water hot water return indirect waste, storm and piping aboveground. All piping shall be insulated with sectional glass fiber insulation, Owens-Corning 2 piece ASJ/SSL. Joints between sections shall be sealed with factory supplied 3 inch wide sealing strips. Sealing by means of Owens Corning self-sealing lap will also be acceptable. Install (anti-sweat) vapor barriers on all cold water piping.

- D. Domestic hot and cold water valves and fittings - Fittings, valves, etc. shall be insulated with flexible blanket insulation compressed to 1/2 its thickness, tied on with jute twine over which shall be applied a flood coat of Insul-Coustic IC-102 and 10-20 open weave glass cloth. Glass cloth to be finished within additional coat of IC-102. Insulation blanket shall be Owens-Corning wrap.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All insulation on pipes running through walls, floors, partitions and beams shall be continuous through sleeves and openings.
- B. Insulation shall be installed only after all tests of the piping system have been completed.
- C. All insulation shall fit snugly.
- D. All surfaces shall be clean and dry when insulation is applied.
- E. Longitudinal joints shall be on least conspicuous side off the pipe.
- F. Valves shall be insulated up to the packing unit.
- G. As specified hereinbefore, all horizontal runs of piping will be supported on adjustable clevis or group trapeze type hangers. Pipe hangers will be installed outside of the insulation. Where hangers occur, prefabricated insulation protective saddles shall be "Insul-Shield-Multi-Purpose-Saddle" as manufactured by Insul-Coustic Corp. or approved equal.
- H. Hot and cold water branch piping extending through slab or knockout panels to serve equipment shall be insulated to a point 4 inch above the top of sleeve provided for pipe.
- I. The use of staples shall not be permitted.
- J. It is the intent of this Specification that all vapor barriers be continuous throughout. Reinstate existing piping at point of new pipe connections.

END OF SECTION 220420

SECTION 220470

TESTS AND ADJUSTMENTS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section.

1.1 TESTS AND ADJUSTMENTS

- A. The Contractor shall, at his own expense, during the progress of the work or upon its completion as ordered make such tests as are specified or as required by and in the presence of the Architects, Building Inspectors, etc. At least 48 hours notice shall be given in advance of all tests.
- B. The Contractors shall provide all apparatus, temporary work or other requirements necessary for all tests. He shall take all due precautions to prevent damage to the building, its contents or the work of the other Contractors, that may be incurred by all tests. This Contractors shall also be responsible for the work of other Contractors that may be damaged or disturbed by the tests or the repair or replacement of his work, and he shall without extra charges, restore to its original condition, any work of other Contractors to do the work of restoration.
- C. Tests on the various systems may be conducted in sections as the work progresses or when the systems are completed.
- D. No caulking of pipe joints to remedy leaks will be permitted except where joints are made with lead and oakum.
- E. Each section of the sanitary, storm and vent piping tested shall have all openings tightly closed with screw plugs, or equal device. The drainage and vent systems shall be filled with water and proven tight under a 10'-0" head for a minimum of four (4) hours. Water level must remain constant through test without adding water.
- F. Upon final completion of the sanitary systems and when all fixtures and appurtenances have been set and the systems are in complete working order, all traps in the systems shall be filled with water and a thick penetrating smoke shall be introduced into the entire system.
- G. As smoke appears at the stack openings on the roof, such openings on the roof shall be tightly closed and a pressure equivalent to 1-1/2 inch of water shall be maintained during the test. Oils of peppermint shall be added at the smoke making machines so that any leakage is readily discernible.
- H. Before any covering is applied to the domestic water piping systems, the entire domestic water piping systems shall be hydrostatically tested for eight (8) hours to a hydraulic pressure of 125 psig.

- I. At the completion of the test, Contractor shall furnish the Owner with one (1) copy of test certificates as issued by the insurance company.
- J. Adjustments: Tests and adjustments shall be repeated as often as necessary until the systems are tight and are to the entire satisfaction of the Plumbing Inspector, Engineers and any other authorities having jurisdiction.
 - 1. Contractor is to thoroughly instruct the building custodian in the proper care and operation of the entire system. Contractor shall prepare for use by custodian, detailed brochures of instructions in non-technical terms, describing the maintenance and operation of all fixtures, apparatus, valves, controls etc. furnished by him.
 - 2. Should any part of the work performed under this Contract fail to function because of cracked piping, obstructions, debris in piping, leaks in piping or any other cause, this Contractor shall disconnect, clean and reconstruct the work at his own expense and pay for any damages to adjoining work.
 - 3. Water flow is to be balanced and adjusted to all flush valves, faucets, etc.
 - 4. All parts of the plumbing system are to be thoroughly flushed until cleared of all grease and sediment and all dirt pockets cleaned. Repeat as often as necessary, open all cleanouts and reset in graphite.
 - 5. All new motors shall be oiled as required.
 - 6. All new valves are to have stuffing boxes packed and adjusted.

END OF SECTION 220470

SECTION 220480

TAGS, CHARTS AND IDENTIFICATION

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 TAGS, CHARTS AND IDENTIFICATION

- A. Every valve installed under this Contract shall be tagged or labeled as follows: Tag shall be etched brass securely fastened to valve handwheels with heavy brass "S" hooks, soldered closed. At lock shield and similar type valves, tags for same shall be securely wired to valve body.
- B. Charts shall be provided for each piping system, as approved and shall consist of schematic diagrams of piping layouts showing and identifying each valve and piece of equipment etc., and its use. Upon completion one (1) copy of diagrams and valve charts suitably framed under glass, shall be furnished and mounted where directed. One (1) copy of diagrams and valve charts shall be delivered to Owner.
- C. This Contractor shall provide on all piping, semi-rigid, wrap around plastic identification markers equal to Seton Snap-Around and/or Seton Strap-On pipe markers.
- D. Each marker background is to be appropriately color coded with a clearly printed legend to identify the contents of the pipe. Directions of flow arrows are to be included on each marker.
- E. Identification of all piping shall be adjacent to each valve, at each pipe passage through wall, floor and ceiling construction and at each branch and riser take-off.
- F. Identification shall be on all horizontal pipe runs, marked every 15 ft. as well as at each inlet outlet of equipment at changes in direction.

END OF SECTION 220480

SECTION 220490

GUARANTEE

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section.

1.1 GUARANTEE

- A. The Contractor shall remove, replace and/or repair at his own expense and at the convenience of the Owner, any defects in workmanship, materials, ratings, capacities and/or characteristics occurring in the work within one (1) year years or within such longer period as may be provided in the Drawings and/or Section of the Specifications, which guarantee period shall commence with the final acceptance of the entire Contract in accordance with provisions stated in the General Conditions, and the Contractor shall pay for all damage to the system resulting from defects in the work and all expenses necessary to remove, replace and/or repair and any other work which may be damaged in removing, replacing and/or repairing the work.

END OF SECTION 220490

SECTION 230100

GENERAL CONDITIONS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

1.1 GENERAL CONDITIONS

- A. Before submitting a proposal, Bidders shall examine all related to this work and shall become fully informed as to the extent and character of the work required and its relation to the other work in the building.
- B. Before commencing work, the Contractor will examine all conditions of the project upon which his work is in any way dependent for perfect workmanship according to the intent of this Specification. No "waiver of responsibility" for incomplete, inadequate or defective adjoining work will be considered unless notice has been filed by this Contractor and acceded to by the Owner's representative in writing before the Contractor begins any part of the work.
- C. The Contractor will pay for all licenses, permits and inspection fees required by civil authorities having jurisdiction. Comply with all laws, ordinances, regulations, and fire underwriter's requirements applicable to work herein specified without additional expense to the Owner. (Also local building code requirements.).
- D. It is specifically intended that anything (whether material or labor), which is usually furnished as a part of such equipment, as is hereinafter called for (and which is necessary for the completion and proper operation) shall be furnished as part of this Contract without additional cost the Owner, whether or not shown in detail or described in the Specifications.
- E. When Drawings and Specifications conflict or there is a question as to the proper intent of this Contract, the Contractor shall assume the greater quantity, the higher quality and/or the more expensive method in his pricing. All questions shall be directed to the Architect/Engineer in writing only and only up to ten (10) days prior to bidding.
- F. The Drawings indicate the general runs of the piping, ductwork, etc. systems and the location of equipment and apparatus, however it shall be understood that the right is reserved by the Architect/Engineer to change the location of piping work, ductwork, equipment and apparatus to a reasonable extent as building conditions may dictate, prior to their installation without extra cost to the Owner.
- G. Small scale drilling through walls and floors or cutting of piping insulation which may contain asbestos shall be performed by a person with a "restricted asbestos handler allied trades certificate" and shall have a copy of it in his possession at all times while working of the project. This shall also apply to removal of piping, ductwork or equipment insulation.

- H. Any changes from the Drawings and Specifications and any interpretation thereof shall have the prior approval of the Architect/Engineer. The Contractor shall submit in writing, at the time of signing the Contract, any items of necessary labor and materials, which, in his opinion, are lacking in requirements of the Drawings and Specifications to insure a complete job in all respects. No consideration will be granted to alleged misunderstanding of materials to be furnished, work to be done, or conditions to be complied with, it being understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein, or indicated on the accompanying Drawings.

END OF SECTION 230100

SECTION 230110

SCOPE OF WORK

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

1.1 SCOPE OF WORK

- A. The work under this section includes all labor, materials, equipment, tools, transportation, and the performance of all work necessary and required for the furnishing and installation complete of all work as shown on the Contract Documents, including but not necessarily limited to the following:
- B. General
 - 1. Rigging of equipment.
 - 2. Furnish all combination motor starter/disconnects for equipment (with the exception of starters and electric items already mounted on equipment or equipment not requiring same). Fan motor starter/disconnects shall have contacts for ATC connection and a terminal block connection for Fire Alarm fan shutdown. Starters per manufacturer's recommendations. Underwriter's inspection and certificate required. Coordinate with Electrical Contractor.
 - 3. Air and Water Balancing.
 - 4. Automatic temperature controls with complete wiring (regardless of voltage).
 - 5. Testing, adjusting and start-up of equipment.
 - 6. Painting and identification of all equipment and piping.
 - 7. Firestopping per NFPA requirements (UL approved systems).
 - 8. Operating and maintenance instructions.
 - 9. As-Built Drawings - Refer to Division 1.
 - 10. Cutting and Patching - Refer to Division 1.
 - 11. Coordination Drawings (if applicable): Attention is directed to Division 1 for coordination drawing requirements for this project. These drawings are critical to the proper execution of the work and failure to honor these requirements may become the basis for denial of any and all claims for either or both "time" and "money".

C. New Addition

1. Packaged outdoor Ventilation energy recovery unit and related appurtenances.
2. Exhaust fan and related appurtenances.
3. Variable frequency drives.
4. Cabinet heaters.
5. Sheetmetal ductwork and related accessories.
6. Duct and pipe insulation.
7. Registers, diffusers and dampers.
8. Hot water distribution piping, valves, and appurtenances.
9. Duct-mounted heating coils.
10. Refrigerant piping and appurtenances.
11. Ductless split VRF system and related appurtenances.

1.2 WORK UNDER OTHER CONTRACTS

- A. Power wiring of motors and equipment.

1.3 REMOVALS

- A. Removals should be coordinated with other trades affected.
- B. Piping which penetrates the construction may be cut and capped provided capping is done beneath the finished surfaces so that construction over it can be achieved.
- C. All removals shall be removed from the site.

1.4 ALTERATION WORK

- A. All equipment, piping, control components, etc. to be removed, shall be disposed of or salvaged as directed by the Owner. They shall not be removed from the premises without the Owner's approval.
- B. All piping to be removed shall be properly plugged or capped so that upon completion of all new work, all abandoned piping shall be concealed in finished areas.
- C. No dead ends shall be left on any piping upon completion of job. The existing system shall be left in perfect working order upon completion of new work.
- D. Location and sizes of existing piping, ductwork, equipment, etc. are approximate. Exact sizes and locations of all existing work shall be verified on the job.

END OF SECTION 230110

SECTION 230200

HYDRONIC SPECIALTIES

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

PART 2 - PRODUCTS

2.1 AIR VENTS

- A. Install at all high points automatic air vents to eliminate air binding. All automatic air vents shall be approved heavy duty type equipped with petcocks and tubing for manual venting. All vents installed in coils, etc. shall be of manual key operated type.
- B. All vents concealed from view shall be accessible through access doors. Vents shall be by Hoffman, Anderson or ITT Bell & Gossett, 125 psig rated.

2.2 PRESSURE GAUGES

- A. Furnish and install pressure gauges on suction and discharge sides of each pump and as required to check operation of equipment; pressure gauges shall have 4-1/2" diameter dials, Ashton, Ashcroft or approved equal.

2.3 THERMOMETERS

- A. Install thermometers at all locations in piping system as noted on Drawings and as required to check system performance. Thermometers shall be installed at the supply and return of coils and 3-way diverting valves as manufactured by Trerice, Weksler or Moeller, with 4-1/2 inch face, cast aluminum case, chrome plated steel ring, white background with black embossed markings, glass window, stainless steel pointer, brass movement, 316 stainless steel bulb. Provide separable, universal angle sockets for all thermometers.

2.4 COMBINATION BALANCING / SHUT-OFF VALVES (Circuit Sensors /Setters and Flow Meters)

- A. Provide Circuit Sensor/Setter balance valves as manufactured by Bell & Gossett or approved equal.
- B. Circuit Sensors: Furnish and install as shown on Drawings, a cast iron wafer-type flow meter designed for low pressure drop operation.
 - 1. The flow meter will be equipped with brass readout valves (with integral check valve) for taking differential pressure readings across the orifice of the flow meter.
 - 2. The flow meter shall be designed to operate at a maximum working pressure of 300 psig at 250 degrees F.

3. The flow meter must be furnished with a calibrated nameplate for determining an accurate system flow rate.
 4. Each flow meter shall be ITT Bell & Gossett Circuit Sensor Flow Meter model no. OP.
- C. Circuit Setters: Furnish and install as shown on Drawings and with manufacturer's recommendations model no. CB calibrated balance valves.
1. Valves to be designed to allow installing Contractor to pre-set balance points for proportional system balance prior to system start-up.
 2. All valves 1/2 inch to 3 inch pipe size to be of bronze body/brass ball construction with glass and carbon filled TFE seat rings.
 3. Valves to have differential pressure read-out ports across valve seat area. Read-out ports to be filled with internal EPT inert and check valve.
 4. Valve bodies to have 1/4 inch NPT tapped drain/purge port.
 5. Valves to have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves to have calibrated nameplate to assure specific valve settings. Valves to be leak-tight at full rated working pressure. Valves 4 inch pipe size to be of cast iron body/brass vane construction with differential pressure read-out ports fitted with internal EPT insert and check valve.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230200

SECTION 230250

PACKAGED ROOFTOP ENERGY RECOVERY UNITS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 SUMMARY

- A. This specification is based on an Energy Recovery model as manufactured by Annexair Inc.
- B. All units shall be factory assembled, internally wired, and 100% run tested to check operation, fan/blower rotation and control sequence before leaving the factory. Wiring internal to the unit shall be numbered for simplified identification. Units shall be ETL listed and labeled, classified in accordance with ANSI-UL 1995 / CAN/CSA C22.2 No.236.
- C. Equipment start-up and project inspection by qualified factory trained representative.

1.2 QUALITY ASSURANCE

- A. All unit(s) shall be factory run tested before shipping.
- B. Electrical components shall be UL listed.
- C. Fans shall be tested in an AMCA equivalent laboratory.
- D. Housing insulation shall comply with NFPA 90A.
- E. Coils shall be tested in accordance to AHRI 410.
- F. Energy recovery exchangers shall be tested in accordance to AHRI 1060, "Rating Air-to-Air Energy Recovery Equipment" and Eurovent standards.
- G. Filters shall be tested in accordance to ASHRAE 52.

1.3 SUBMITTALS

- A. Include product description, model, dimensions, component sizes, rough-in requirements, service sizes, and finishes. Include rated capacities, operating weights, furnished specialties, and accessories.
- B. Submit coordination drawings. Include unit details, plans, elevations, sections, details of components. Show support locations, type of support, weight and required clearances.

- C. Submit wiring diagrams including power, signal, and control wiring.

1.4 EXTRA MATERIALS (OPTIONAL)

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.5 WARRANTY

- A. Annexair Inc. (hereinafter referred to as “Annexair”) warrants products manufactured by it to be free of defects in material and workmanship under normal use and service for a period of twelve (12) months from start-up or eighteen (18) months from the date of invoice, whichever occurs first. Annexair’s obligation under this warranty is limited to repair or replace of any part(s) of Annexair unit’s which after Annexair’s examination shall disclose to its satisfaction to have been defective.
- B. THIS WARRANTY DOES NOT COVER LABOR, DIAGNOSING (TROUBLESHOOTING), PREMIUM FOR OVERTIME, TRANSPORTATION, OR ANY OTHER COSTS ASSOCIATED WITH REMOVAL OR REPLACEMENT OF DEFECTIVE PART(S) COVERED UNDER THIS WARRANTY. THE REPLACEMENT OF A SECOND FAILURE OF THE SAME PART WILL NOT BE COVERED UNDER ANY CIRCUMSTANCE FOR THIS STANDARD AND ALL EXTENDED WARRANTIES.
- C. Annexair considers equipment original start-up when the unit and/or fans are started for operation regardless of: -when the building may be ready for operation, -duct work not yet completed, -building management system (BMS) not yet completed, -unit balancing not yet completed.
- D. Minimum (5) five year compressor warranty shall be provided, parts only – labor not included.
- E. The installing contractor must be responsible for warranty service and maintenance after the equipment is placed into operation.
- F. NOTIFICATION: Any modification to the Annexair equipment, including the controls and sequence of operation, without specific approval in writing by Annexair, will result in a violation of the equipment warranty.

1.6 REFERENCES

- A. All components selected for this project shall conform to the following Standards:
 - 1. AFBMA 9: Load Ratings and Fatigue Life for Ball Bearings
 - 2. AMCA Standard 99: Standards Handbook
 - 3. AMCA /ANSI Standard 204: Balance Quality and Vibration Levels for Fans

4. AMCA Standard 210: Laboratory Methods of Testing Fans for Ratings
5. AMCA Standard 300: Reverberant Room Method for Sound Testing of Fans
6. AMCA 320; Laboratory Method for Sound Testing of Fans Using Sound Intensity
7. AMCA Standard 500: Test Methods for Louvers, Dampers and Shutters
8. AHRI Standard 1060: Air-to-Air Energy Recovery Ventilation Equipment
9. AHRI Standard 410: Forced-Circulation Air-Cooling and Air-Heating Coil
10. AHRI Standard 1350: Mechanical Performance Rating of Central Station Air-handling Unit Casings
11. ASHRAE Standard 52: Gravimetric and Dust Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter
12. ASHRAE 52.2: Procedures for Testing Air Cleaning Devices Used for Removing Particulate Matter
13. ASHRAE 84-91: Method of Testing Air-to-Air Heat Exchangers
14. ASHRAE/ANSI Standard 111: Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems
15. ASTM A-525: Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
16. NEMA MG-1: National Electrical Manufacturers Association Motor Standards
17. NFPA 90A: Standard for the Installation of Air Conditioning and Ventilating Systems
18. SMACNA: Sheet Metal and Air Conditioning Contractors National Association
19. UL Standard 1995: Heating and Cooling Equipment
20. UL Standard 900: Test Performance of Air Filter Units

1.7 COORDINATION

- A. Coordinate location and installation of air-handling units. Revise locations and elevations to suit field conditions and to ensure proper operation.
- B. Coordinate location and installation of air handling units with the electrical, mechanical, and plumbing contractors.

PART 2 - PRODUCTS

2.1 HOUSING

A. THERMO-COMPOSITE PANELS (*with thermal break frame*)

1. The unit housing shall be no-through metal with 2" Thermo-Composite and foam panel construction - interior and exterior. or an all-aluminum 4" Foam thermal break construction - interior and exterior. Thermal break construction using a gasket to insulate two panels is not an acceptable equivalent to a no-through metal constructed casing. No-through metal construction will be inherent to all the component construction in the assembly.
2. The unit housing shall be constructed from a frame, base and panel assembly. Unit shall be completely factory assembled and shipped in one piece as shown on drawings.
3. Base structure shall be fully welded G-90, painted exterior, and have integral lifting lugs which can be removed once the unit is installed.
4. The frame shall consist of anodized extruded aluminum profiles which incorporates a thermally broken construction; welded together for reinforcement and insulated for superior thermal performance.
5. All panels and access doors shall be double wall construction with R14 foam insulation for every 2" of construction. All foam insulation must be Greenguard certified®. Any insulation incorporating CFCs or HCFCs in its construction is strictly prohibited from this application.
6. Thermo-Composite or aluminum panels shall be provided for the entire unit construction, including but not limited to, walls, doors, floors, roof, interior partitions, and electrical compartment. Panels shall be non-load bearing type.
7. Unit casing will have no exterior condensation at interior AHU temperatures down to 42.5F while unit exterior conditions are maintained at 95 F dry bulb / 85 F wet bulb. The air handling unit manufacturer shall submit a copy of the test report demonstrating the general construction of the unit housing thermal performance. The test shall include placing the housing panels in a climate chamber and exposing the unit to the conditions mentioned previously. If the manufacturer does not have access to a Climate Chamber such equipment, an independent testing agent must be hired to transport the test unit to a qualified test facility and perform the test at the expense of the manufacturer. Inability to provide this option to the engineer will make the manufacturer ineligible to bid on this project.
8. The panels shall be tested in accordance with SMACNA and ASHRAE 111 to have a deflection of no more than L/1150 at 10" (Exceeding AHRI casing deflection rating class CD1) and 1% leakage rate at 8" pressure and meet AHRI 1350 Casing Air Leakage rating Class 6.
9. Fire resistance of the panel will be in compliance with UL 94 rated at 5VA; and a flame spread / smoke development in compliance with UL 723 ASTM E84 Class 1 rating.

10. All roof and side wall seams shall be positively sealed to prevent water and air leakage. The OA compartment shall have 1.25" PVC drains extended to exterior of unit (outdoor units only).
11. Floor duct openings shall be covered with 1" fiberglass safety walk on gratings.
12. Access doors shall be provided to all major components to facilitate quick and easy access. Access doors will be made from the same material as the unit casing and shall incorporate thermal break construction. Fan access door(s) shall have Allegis type handles, with one handle interlinking multiple latches and threaded insert fastening handles for all remaining doors. If access doors do not open against unit operating pressure, provide safety latches that allow access doors to partially open after first handle movement and fully open after second handle movement. Hinges shall be Nylon hinge type designed to open 180 degrees. Removable panels provided for equipment pull out for coil(s), and air to air heat exchanger section(s) shall have key tooled threaded insert fasteners.
13. Unit shall have the entire exterior finished with a PVDF coating designed for UV resistance. Panels shall be painted Annexair standard color white gray RAL 9002. If custom color is required, please specify the associated RAL color code (per factory approval). Panels shall pass ASTM B117 3000-hour salt fog resistance test and ASTM D4585 3000-hour moisture condensation resistance test. In addition, paint must meet AAMA 620-02 standard for color, chalking, gloss retention, and abrasion resistance.
14. Outdoor units shall have a rain gutter above each access door and a watertight roof shall be provided with a white TPO UV-reflective membrane. Indoor units do not have the TPO membrane.
15. The air handler unit casing shall be provided with a lifetime warranty against corrosion under normal use.

B. WEATHER HOODS

1. The outdoor intake weather hood shall be completely constructed in aluminum for superior corrosion resistance. The hood shall ship loose for field installation by the installing contractor. Painted galvanized hoods shall not be acceptable due to its susceptibility to corrosion. The outdoor air hood shall be designed with a 4" extruded aluminum louver, bird screen and a plenum enclosure with drain holes. The louver blades shall be drainable type with a maximum 45 degree angle and curved with integral rain baffle. The louver design shall not allow more than 0.03 oz/ft² water penetration when tested in accordance to AMCA 500. The pressure drop of the complete hood assembly shall not exceed 0.05"wc at a maximum 500 fpm face velocity.

2. A Pre-filter rack system shall be installed within the weather hood enclosure to prevent outdoor air dust and debris from entering the damper and unit casing plenum. Pre-filters installed inside the unit casing plenum and downstream of the outdoor damper will not be acceptable as this will increase overall maintenance on the damper, reduce indoor air quality and promote mold and bacteria growth. Filter access in the hood shall be accomplished via the louver that is installed with a stainless steel piano hinge and spring loaded latch. No tools or ladders shall be required to access the pre-filters in the weather hood assembly.

C. EXHAUST AIR LOUVER

1. The exhaust air outlet louvers shall be 2" extruded aluminum, with non-restricting blade design and bird screen.

2.2 HEAT RECOVERY FIXED PLATE

A. ENTHALPY PLATE HEAT EXCHANGERS (IPE5 Innergytech)

1. The enthalpy plate energy exchanger shall transfer both sensible and latent energies between outgoing and incoming air streams in a cross flow arrangement.
2. The enthalpy plate exchanger manufacturer must have at least ten (10) years of experience in the manufacturing of energy recovery components.
3. The enthalpy plate exchanger media shall be impregnated with a polymeric desiccant.
4. The hygroscopic polymer shall exchange water by direct vapor transfer using molecular transport without the need of condensation.
5. The plate exchanger shall be constructed of alternate layers of corrugated open mesh aluminum material and polymeric desiccant impregnated media.
6. The enthalpy plate exchanger shall have a unique rectangular flute design to provide very low pressure drop values and optimal energy transfer. Triangular flute openings are unacceptable.
7. The enthalpy plate exchanger core shall be assembled into a strong, self-supporting frame made of aluminum corner extrusions and 16 gauge aluminum end plates.
8. The corners of enthalpy plate exchanger shall be sealed with a 2 components casting resin. The exchanger shall be silicone free.
9. The aluminum corner extrusions shall be hollow to accept mounting screws and shall provide a 45° corner support angle.
10. The enthalpy plate exchanger shall operate at temperatures between -40 °F and 140 °F (-40 °C and 60 °C).
11. The enthalpy plate exchanger shall withstand, without more than 10 % increase of pressure drop, pressure differentials of at least 5" w.g. It shall withstand pressure differential of 10" w.g. without permanent deformation.
12. The enthalpy plate exchanger shall bear the AHRI 1060 Certified Product Seal. Sensible, latent and total effectiveness along with pressure drop, EATR and OACF rating shall be clearly documented with performance tests conducted in accordance with ASHRAE Standard 84-91 and per the official AHRI laboratory. Exchangers that do not bear the AHRI 1060 certified seal shall be unacceptable.

13. Fire resistance: Following UL1995 (Heating and Cooling Equipment), the enthalpy plate exchanger shall be a UL Recognized Component and bear the UL Certification Mark (tested under UL723 with success by the UL laboratory). Exchangers only tested in accordance to UL723 shall be unacceptable.
14. Bacteria & mold resistance: The membrane shall not promote the growth of mold or bacteria and must have successfully passed AATCC30-2013 with no growth of *Aspergillus Niger* observed after 14 days.
15. Longevity test (frosting/defrosting cycles): The exchanger must have successfully passed 1920 frosting/defrosting cycles with less than 10% change of its performance.
16. Frost control shall be accomplished by face & bypass damper where temperatures fall below freezing. Any other form of defrost shall not be acceptable.

2.3 FANS

A. EC-SPIDER FANS WITH PM MOTOR AND SPEED CONTROLLER (ANNEXAIR)

1. Fans shall be direct drive with non-obstructive air intake and externally mounted motor. Fans shall be compact, optimized and construction made of aluminum with 7-blade airfoil geometry protected by an epoxy powder coating.
2. To reduce vibration, the impeller shall be balanced to an admissible vibration severity of less than 3.8 mm/s (0.15in/s). Tests shall be made according to ANSI/AMCA Standard 204-05 Fan Application Category for balance and vibration: HVAC BV-3, Balance Quality Grade for rigid Rotors / Impeller: G6.3.
3. The fan and motor assembly shall be directly wall mounted without isolation.
4. Fan will require to be operated by a variable speed drive.
5. The permanent magnet motors shall have high efficiencies (up to 93%+controller) with low noise, low vibration output, compact design, longer life, increased torque at start, reduced heat losses and reduced friction between components.
6. The motor should be able to operate between -4F and +140F ambient temperature.
7. Dust and humidity protection should be IP54.
8. An insulated shaft-rotor kit will be provided to reduce shaft voltage electrical damage to motor bearings.
9. Speed controller will be used to set or regulate the fan speed and airflow for these units.
10. The speed controller shall be capable of controlling an IPM (Internal Permanent Magnet) motor to 400Hz. An auto-tuning system shall provide the ability to drive any IPM motors.
11. The efficiency of the speed controller at 100% speed and load shall not be less than 95%.
12. There shall be a regenerative avoidance function to minimize the effect of opposite rotation of another fan within the same duct and have Out-of-Range warning system to detect any potential mechanical problems.
13. The speed controller shall have momentary power-loss ride-thru capability.
14. The speed controller shall incorporate PID and Dual PID for process controls such as flow rate, air volume, or pressure.
15. The input power section shall utilize a full wave 6-pulse bridge design incorporating diode rectifiers. The diode rectifiers shall convert AC line power of fixed voltage and frequency to fixed DC voltage. This power section shall be

- insensitive to phase sequence of the AC line voltage.
16. The output power section shall change fixed DC voltage to adjustable frequency AC voltage. This section shall utilize insulated gate bipolar transistors (IGBT's).
 17. The speed controller includes 3 sets of user adjustable skip frequencies and choice of 0-5Vdc, 0-10Vdc or 4-20mA speed reference for input and output.
 18. The speed controller shall incorporate a dedicated USB port for programming.
 19. The speed controller will have PWM control, RS-485 / Modbus RTU and BACnet MS/TP communication as standard, & carrier frequency up-to 14.5 KHz.
 20. Control logic terminals shall be of the clamp / vibration resistant type.
 21. The speed controller shall incorporate a radio filter capable of meeting product standard EN61800-3 for Second (2nd) Environment.
 22. The speed controller shall have built-in PLC capable of 6k steps.
 23. Speed controller shall be installed as shown on drawings with contactors, relays, and all specified accessories.

2.4 FILTERS (DAFCO FILTRATION FROUP)

A. PRE-FILTERS (*HIGH CAPACITY SERIES 400 2" MERV 10*)

1. Filters shall be factory installed where shown on the drawings.
2. The filters shall be Filtration Group Series 400, MERV 10.
3. Media shall be 100% synthetic, mechanical media that does not support microbial growth.
4. Frame shall be a heavy duty, high strength, moisture resistant paperboard with a cross member design that increases filter rigidity and prevents breaching. Frame shall be recyclable.
5. Filters shall have an expanded metal support grid bonded to the air-exiting side of the filter to maintain pleat uniformity and prevent fluttering. Metal support grid shall be recyclable.
6. MERV 10 model High Capacity Serie 400 filters are classified to UL 900 and tested in accordance with the ASHRAE test 52.2.
7. Filter shall have a low initial pressure drop that shall not exceed 0.17" w.g. in 2" at 500 fpm air flow, and 0.11" in 4" at 500 fpm air flow. Filters shall have a recommended final resistance of 1.0" w.g.
8. Filters shall be rated to withstand a continuous operating temperature up to 200°F.
9. Filters shall be placed in a completely sealed, galvanized holding frame with quick release latches for easy replacement.

B. FINAL FILTERS (*GEOPLEAT4" MERV 13 (90-95%)*)

1. Filters shall be factory installed where shown on the drawings.
2. The air filters shall be Filtration Group Geopleat mini-pleat MERV15.
3. Media shall be 100% synthetic gradient dual density media that does not support microbial growth.
4. Frame shall be constructed with high-impact plastic and impervious to moisture and high humidity.
5. Media pack shall be adhered to plastic frame on all sides to prevent air by-pass.
6. Filter shall have a hot melt bead separator to maintain pleat pack stability and ensure consistent pleat spacing for optimum air flow.

7. MERV 15 model Geopleat filters are classified to UL 900 and tested in accordance with the ASHRAE test 52.2.
8. Filter shall have a low initial pressure drop that shall not exceed 0.36" w.g. in 4" at 500 fpm air flow. Filters shall have a recommended final resistance of 1.5" w.g.
9. Filters shall be rated to withstand a continuous operating temperature up to 150°F.
10. Filters shall be placed in a completely sealed, galvanized holding frame with quick release latches for easy replacement.

2.5 DAMPERS

A. AIR FOIL CONTROL DAMPER (TAMCO SERIES 1000)

1. Dampers shall be installed where shown on the drawings.
2. Dampers shall be low leak type (Leakage Class 1A at 1 in. w.g. (0.25 kPa) static pressure differential).
3. Blades are maximum 6" deep extruded aluminum air-foil profiles. All blades are symmetrically pivoted. Galvanized dampers will not be acceptable.
4. Blade seals are extruded EPDM. Frame seals are extruded silicone. Seals are secured in an integral slot within the aluminum extrusions. Blade and frame seals are mechanically fastened to prevent shrinkage and movement over the life of the damper.
5. Dampers shall be opposed blade type and installed in the compartments (as shown on the drawings) with linkage rod for actuators, unless otherwise noted.
6. Actuators shall be 24V factory installed; two-position or modulating (please refer to the unit schedule).
7. All actuators shall have spring return mechanism and auxiliary switches. Dampers will be installed in the failed close positions unless otherwise noted.

2.6 CONDENSING UNIT

A. AIR COOLED CONDENSING UNIT WITH VARIABLE SPEED COMPRESSORS (AEROMOD)

1. Provide an integral AIR COOLED CONDENSING UNIT (ACCU) section with variable speed compressors. The condensing section shall be factory piped, wired, and charged with R-410A refrigerant. The section shall be from the same manufacturer as the air handling unit. Factory mounting and piping the condensing unit, provided by a third party is not acceptable. Furthermore, the exterior cabinet of the ACCU section shall be of the same construction and paint color as the air handling unit.
2. Compressors shall be variable speed scroll type that can modulate from 33% to 100 capacity per compressor. Variable capacity compressors which do not modulate the speed of the scrolls are not considered equal to a variable speed scroll since they consume more energy at the same capacity output. Mechanically stepped scrolls which are unloaded via a digital signal to a solenoid valve, in a timed sequence, will not be acceptable for this application. The variable speed scrolls shall be operated via a factory supplied variable speed controller per

compressor, and all tandem compressors will modulate in unison. Using a single variable speed controller on the lead circuit alone is not efficient during part load conditions, therefore will not be acceptable for this application. Each compressor and controller assembly shall be equipped with the following features: PERMANENT MAGNET MOTOR, electronic expansion valve, a crankcase heater function, anti-short cycling, built-in phase loss detector, EMC filter, oil return management system, and reverse rotation protection. All refrigeration parts, including the compressor and the speed controller will be located in a closed and vented service compartment, separate from the condenser coil airflow. Compressors located in compartments open to the outside are not acceptable. Compressors shall be mounted on rubber isolators to limit vibration transmission.

3. All ACCU above 20 tons will have a minimum of two compressors.
4. Condenser fans shall have 7 blades with external mounted asynchronous motors that are class F insulated, IP54 and 100% variable speed. Each condenser fan bank shall be provided with a variable frequency drive which modulates via refrigerant head pressure control for superior part load performance. All the condenser fans in a fan bank shall modulate in unison for each respective circuit. Staging condenser fans are not an acceptable mode of control for head pressure control.
5. Protective guards shall be included on all condenser fans, and condenser coils. The coil protective guard shall be ideal to keep coil at maximum operating performance, protect the condenser coil from hail damage and allow for easy cleaning with quick removal system.
6. The condenser coils shall be micro-channel design (Al/Al) for maximum efficiency performance, consist of a single pass arrangement with integral receiver, and be pressure tested at 650 psig. Each coil shall be treated with a Trivalent Chrome Process (TCP) coating to provide 2500 hr salt spray resistance, only available standard on micro channel coils.
7. The following components shall be included in each refrigeration circuit: Liquid line filter dryer, hi and low pressure switch, hi and low pressure transducers, suction and liquid lines shutoff valves and suction line accumulators. In addition, refrigeration piping must use Shrader type connections for all components, including but not limited to valves and transducers. Under no circumstances shall the units leave the factory without a complete run test and a copy of the QC report shall be provided upon request.
8. Minimum (5) five year compressor warranties shall be provided.

9. The standard ambient temperatures are 40F to 125F. Unit comes standard with head pressure control that can allow cooling operation down to 0F ambient air, given the ambient wind conditions permit (Max 5 mph or unit may trip on low pressure). For any lower ambient conditions, please contact factory.

2.7 COILS

A. DX COILS

1. Coils shall be factory installed in the unit.
2. Coils shall be designed with respective circuits to match the design requirements.
3. All coils shall have a distributor per circuit connection. Coils shall be circuited for counter-flow heat transfer to provide maximum mean effective temperature difference for maximum heat transfer rates.
4. Primary surface shall be round seamless (3/8" O.D.) copper tube staggered in the direction of airflow. Secondary surface shall consist of rippled aluminum plate fins for higher capacity and structural strength. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Headers shall have intruded tube holes to provide a large brazing surface for maximum strength and inherent flexibility.
5. Casing shall be constructed of continuous galvanized steel.
6. The complete coil shall be tested with 315 pounds air pressure under warm water and be suitable for operation at 250 psig working pressures. Maximum finned coil height shall be 60" and shall not exceed 500 FPM face velocity.
7. Drain pan shall be provided on cooling coils. Cooling coils shall sit on stainless steel support rails, which shall stand a minimum of (2) two inches above the highest point of the floor drain pan. Stacked coils shall be provided for larger airflows and intermediate drain pans shall be provided for each coil bank. Drain pans shall be 316 stainless steel with 1.25" MPT stainless steel drain connections on one side only. Pan shall be sloped in three planes.

B. HOT GAS REHEAT

1. Coils shall be factory installed in the unit.
2. The hot gas reheat coil shall be installed at 4" from the moisture producing DX cooling coil. A plexi glass between the two items shall be required to visually inspect the DX cooling coil surface area, and also have the ability to clean the coils when necessary.

3. A modulating valve shall be provided to control air leaving temperature for dehumidification.
4. Coils shall be designed with respective circuits to match the design requirements.
5. Primary surface shall be round seamless (3/8" O.D.) copper tube staggered in the direction of airflow. Secondary surface shall consist of rippled aluminum plate fins for higher capacity and structural strength. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Headers shall have intruded tube holes to provide a large brazing surface for maximum strength and inherent flexibility.
6. Casing shall be constructed of continuous galvanized steel.
7. The complete coil shall be tested with 315 pounds air pressure under warm water and be suitable for operation at 250 psig working pressures.

2.8 POWER AND SAFETY CONTROL

- A. The power and control center shall be integral to the unit housing and rated equivalent to NEMA 4X.
- B. Under no circumstances shall any wiring or parts be field installed. If units show up at the job site without wiring by the manufacturer, the contractor will have to send back units to the manufacturer at the contractors' expense to get them factory wired and re-tested.
- C. Panels that are externally mounted to the unit shall not be accepted, regardless of the NEMA rating they may have.
- D. Each panel should have a separate access door with an approved locking device.
- E. All electrical components contained in the panel shall be UL/CSA certified and labeled. The unit shall be complete with VFDs, fuses, relays, phase protection for compressorized units, terminals for main ON/OFF and step-down transformer. All components shall be factory wired for single point power connection by the manufacturer of the unit. A non-fused safety disconnect switch shall be factory installed for ON/OFF servicing.
- F. An electrical pipe chase for power and control feeding shall be provided next to the control panel.
- G. The Short Circuit Current Rating (SCCR) is 5 KA (208/460 V) rms symmetrical, as noted on schedule.
- H. GFI (120 V/1), lights and switches shall be factory installed and wired to a common junction box, powered by others (a separate 120V/1 required).
- I. Phase loss monitor.

2.9 AIR TEMPERATURE CONTROL PACKAGE

- A. The unit shall be delivered with factory installed control system. Under no circumstances

shall control be provided by other than the manufacturer of the equipment. Field installed control package by the ATC will not be acceptable.

- B. The control system shall consist of a microprocessor with 8-lines and 22-characters built-in LCD display, allowing for full monitoring of all the unit equipment. Six push buttons allow for menu navigation and settings modification as required. Remote access ports also allow for potential program upgrade, operation log download and unit monitoring.
- C. Refer to the Sequence of Operation and control schematic for detailed description of control logic and options.
- D. Refer to control schematic for all field installed control components and control capability to and/or from others.
- E. Communication Interface Card: The microprocessor shall be capable of communicating with the following protocol language: Bacnet MS/TP RS-485

2.10 ADDITIONAL ACCESSORIES AND UNIT FEATURES

- A. Dirty filter switch
- B. Rotation detector (where applicable)
- C. Door interlocking switch (for fan section)
- D. Magnehelic gauges (Dwyer 2000 model)
- E. Condensate overflow switch (for drain pans)

F. OA Air Flow Monitoring Package – IAQ-TEK

The airflow measuring station shall consist of a special probe, a transducer and a display. The probe will be designed to be accurate in turbulent airflow and will be a standard design to fit all ducts. Only the number of probes will change based on the surface area. Probes can be washed down if required. The high accuracy transducer shall be mounted inside a NEMA 4 enclosure where temperature is controlled and shall also include an auto-zero function to prevent drifting. The display will indicate airflow, temperature and alarms. It will also serve as the interface to configure the system via an internal Set-up Wizard. This Set-up Wizard will include start-up, commissioning and diagnostics functions without the use of a laptop computer or other tools. All calculations, and management operations will be done within the display unit. The accuracy shall be +/- 5% of reading between 200 and 965 ft/min and +/- 10% of reading between 75 and 200 ft/min. as per Tek-Air series IAQ-Tek.

G. Fan Airflow Monitoring Station Package

The unit shall be delivered with factory installed airflow measuring system. The airflow measuring system, consisting of a piezometer ring and transducer, shall be installed on the fan. The package consists of an inlet port on the fan inlet cone connected with flexible tubing to the transducer.

H. Fan Airflow Balancing Package – EZBALANCER

The EZBalancer controller is designed to set and monitor unit airflow of the fans without adjusting VFD settings by simply using keypad buttons. Field VFD adjustments are no longer required. Unit CFM readings are continuously displayed on the LCD screen and a 4-20 mA signal sent to others (BMS). One (1) EZBalancer is required for up to two (2) airflows even if multiple fans are used. It can be applied for constant and variable airflow applications with a 0-10Vdc signal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine ducts, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install Air Handling Unit per manufacturers' instructions.
- B. Install with required clearance for service and maintenance.

3.3 TESTING

- A. System verification testing is part of the commissioning process. Verification testing shall be performed by the Contractor and witnessed and documented by the Commissioning Authority. Refer to section 230485, Commissioning, for system verification tests and commissioning requirements.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections. Report results in writing.
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove malfunctioning units, replace with new units, and retest.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

1.1 TRAINING

- A. Training of the Owner's operation and maintenance personnel is required in cooperation with the Commissioning Authority. Provide competent, factory-authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the Commissioning Authority after submission and approval of formal training plans. Refer to System Demonstrations, section XXXXX, for contractor training requirements. Refer to section 230470, Commissioning, for further contractor training requirements.
- B. Contact Annexair to request pricing to include factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain humidifiers.
 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining equipment and schedules.
 2. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
 3. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
 4. Schedule training with Owner, through Architect, with at least seven days advance notice.

END OF SECTION 230250

SECTION 230255

VARIABLE REFRIGERANT FLOW OUTDOOR UNITS

PART 1 – GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 SYSTEM DESCRIPTION

- A. Indoor units are matched with heat pump or heat recovery VRF (variable refrigerant flow) outdoor unit.

1.2 DELIVERY, STORAGE AND HANDLING

- A. Units shall be stored and handled per unit manufacturer's recommendations.

PART 2 – PRODUCTS

2.1 MULTI V™ 5 HEAT RECOVERY AND HEAT PUMP SYSTEM(S) – (6 to 42 tons nominal)

MULTI V™ S HEAT PUMP AND HEAT RECOVERY SYSTEM(S) – (2 to 5 tons nominal)

A. Product Design

1. LG Multi V heating and cooling system shall be an air cooled system allowing user to configure in the field a heat pump or a heat recovery system consisting of one to three outdoor unit modules, conjoined to make a 2-5 ton single refrigerant circuit for the Multi V S system, and 6-42 single refrigerant circuit for the Multi V 5 system.
 - a. Heat recovery systems, employing three pipes, shall be connected to Heat recovery (heat recovery) unit(s) and indoor unit(s). Multi-port heat recovery units shall allow simultaneous heating and cooling of individual zone(s) at various capacities as required to satisfy their zone requirements.
 - b. Heat pump systems shall require two pipes, simultaneous heating and cooling shall not be supported. The heat recovery system shall consist of three pipes, liquid, suction and hot gas pipes. Heat recovery systems operating at 0°F that cannot deliver single phase superheated refrigerant vapor at a minimum of 162°F while operating in the heating mode shall not be acceptable.
2. All three-phase VRF heat pump and heat recovery outdoor units shall be from the same product development generation. Mixing of outdoor units from different development generations is not acceptable.

B. Operating Conditions

1. Outdoor Unit shall be capable of continuous compressor operation between the following operating ambient air conditions, operation outside of these conditions are possible and may involve non-continuous operations.
2. Operating Ambient Air Conditions
 - a. Cooling: 5°F DB to 122°F DB (With optional low ambient kit from -9.9°F DB to 122°F DB)
 - b. Heating: -22°F WB to 61°F WB
 - c. Cooling Based (ODU reversing valve in cooling position) Synchronous: 14°F DB to 81°F DB (Heat Recovery Operation Only)
 - d. Heating Based (ODU reversing valve in heating position) Synchronous: 14°F WB to 61°F WB (Heat Recovery Operation Only)

C. Electrical

1. All air source heat pump and heat recovery frame(s) shall be designed and electrically protected to maintain stable continuous compressor operation when provided with 460/60/3 power with the following specifications:
 - a. 460/60/3
 - i. Voltage tolerance 414V
 - b. Voltage imbalance of up to two percent;
 - c. Power surge of up to 5kA RMS Symmetrical.

D. General Features

1. The air-conditioning system shall use R410A refrigerant.
2. Each system shall consist of one, two or three air source outdoor unit modules conjoined together in the field to result in the capacity specified elsewhere in these documents.
3. Dual and triple frame configurations shall be field piped together using manufacturer's designed and supplied Y-branch kits and field provided interconnecting pipe to form a common refrigerant circuit.
4. System shall have following frame configurations vs. capacity.
2 to 20 ton units shall be a single frame only.
22 to 34 ton units shall be dual frame only.
36 to 42 ton heat recovery units shall be triple frame only
5. System shall employ self-diagnostics function to identify any malfunctions and provide type and location of malfunctions via fault alarms.
6. All outdoor units, regardless of the Heat Pump or Heat Recovery models, shall be the same generation and provide with most up to date firmware version at the time of delivery. Manufacturers commissioning agents shall assure the owner in the commissioning report that the latest software version.

7. If the specifications include both heat pump and heat recovery outdoor models, the manufacturer shall provide the most recent generation equipment only. Old stock or obsolete models will not be accepted. Products purchased over the internet and not from the manufacturer's authorized local mechanical representative or authorized distributor will not be accepted.
8. Field Provided Refrigerant Piping:
 - a. The refrigerant circuit shall be constructed using field provided ACR copper, de-hydrated, refrigerant rated copper pipe, piped together with manufacturer supplied Heat recovery unit(s) and Y- branches, as may be required, connected to multiple (ducted, non-ducted or mixed combination) indoor units to effectively and efficiently control the heat pump operation or simultaneous heating and cooling operation of the heat recovery VRF system. Other pipe materials, if used, shall perform, at a minimum, as well as that specified above, shall not have any adverse reactions, for example galvanic corrosion, to any other components or materials also in use in the system and shall be installed per manufacturer's instructions.
 - b. The unit shall be shipped from the factory fully assembled including internal refrigerant piping, inverter driven compressor(s), controls, temperature sensor, humidity sensor, contacts, relay(s), fans, power and communications wiring as necessary to perform both Heat Pump and Heat recovery operations.
 - c. Each outdoor unit refrigeration circuit shall include, but not limited to, the following components:
 - i. Refrigerant strainer(s)
 - ii. Check valve(s)
 - iii. Inverter driven, medium pressure vapor injection, high pressure shell compressors
 - iv. Liquid refrigerant cooled inverter PCB
 - v. Oil separator(s)
 - vi. Accumulator /controlled volume receiver(s)
 - vii. 4-way reversing valve(s)
 - viii. Vapor injection valve(s)
 - ix. Variable path heat exchanger control valve(s)
 - x. Oil balancing control
 - xi. Oil Level sensor(s)
 - xii. Electronic expansion valve(s)
 - xiii. Double spiral tube sub-cooler (s) and EEV
 - xiv. Vapor Injection Valve(s)
 - xv. High and low side Schrader valve service ports with caps
 - xvi. High/low Service valves
 - xvii. Threaded fusible plug
 - xviii. High pressure switch

9. Field Insulation:
 - a. All refrigerant pipe, y-branches, elbows and valves shall be individually insulated with no air gaps. Insulation R-value (thickness) shall not be less than the minimum called for by the local building code, local energy code or as a minimum per manufacture installation requirements. In no case shall the insulation be allowed to be compressed at any point in the system.
 - i. All joints shall be glued and sealed per insulation manufactures instructions to make an air-tight assembly.
10. Microprocessor:
 - a. Factory installed microprocessor controls in the outdoor unit(s), heat recovery unit(s), and indoor unit(s) shall perform functions to optimize the operation of the VRF system and communicate in a daisy chain configuration between outdoor unit and heat recovery unit(s) and indoor unit(s) via RS485 network. Controls shall also be available to control other building systems as required from the VRF control system. DIO/AIO capabilities shall be available as well as a central controller to perform operation changes, schedules and other duties as required by this specification. Addition of separate building control system shall not be required. Other control devices and sequences shall be as specified in other sections of this project specification
11. Inverter PCB Cooling:
 - a. Cooling of the inverter PCB shall be conducted by way of high pressure, sub-cooled liquid refrigerant via heat exchanger attached to the inverter PCB. The full capacity flow of refrigerant shall pass though the heat exchangers to maximize the cooling effect of the PCBs and to aid in the evaporation process and capacity of the outdoor coil during the heating mode. The recovered heat of the PCBs must be used to enhance the overall heating process, other uses or dissipation of heat to ambient shall not be permitted.
12. Compressor Control:
 - a. Fuzzy control logic shall establish and maintain target evaporating temperature (Te) to be constant on cooling mode and condensing temperature (Tc) constant on heating mode by Fuzzy control logic to ensure the stable system performance.
13. Initial Test Run (ITR) (Heating or Cooling) / Fault Detection Diagnosis (FDD) Code:
 - a. This control mode shall monitor and display positive or negative results of system initial startup and commissioning. Heating or Cooling ITR mode will be automatically selected. It shall monitor and provide performance metrics for the following, but not be limited to, refrigerant quantity charge, auto-charge, stable operations, connection ratios, indoor unit status, error status, and number of indoor units connected. This control mode shall not replace the system error monitoring control system.

14. BMS Integration:
 - a. The VRF system shall be able to integrate with Building Management Systems via BACnet™ IP gateway. This gateway converts between BACnet™ IP or Modbus TCP protocol, and RS-485 LGAP (LG Aircon protocol) allowing third party control and monitoring of the LG A/C system, or LonWorks™ gateways. See controls specification for points list.
15. Wi-Fi Communication:
 - a. The outdoor unit shall be Wi-Fi enabled and capable. Wi-Fi shall allow service or maintenance personal access to the complete operating system, via LGMV mobile, without need of tools other than smart phone or tablet. Active live system review, collection of all system data for a field determined duration presented in a .csv file format or collection of all operating conditions, including all indoor units, valves, sensors, compressor speeds, refrigerant pressures, etc., by snapshot of conditions and placing that snapshot into a power point slide to be reviewed at another time. Systems that require computers, hard wire only connection or other devices to collect, review or record operating conditions shall not be allowed.
16. Indoor Unit Connectivity:
 - a. The system shall be designed to accept connection up to 64 indoor units of various configuration and capacity, depending on the capacity of the system.
17. Power and Communication Interruption:
 - a. The system shall be capable of performing continuous operation when an individual or several indoor units are being serviced; communication wire cut or power to indoor unit is disconnected. Systems that alarm and/or shut down because of a lack of power to any number of indoor units shall not be acceptable.
18. Connection Ratios:
 - a. The maximum allowable system combination ratio for all VRF systems shall be 130% and the minimum combination ratio shall be 50%.
19. Comfort Cooling Mode:
 - a. Comfort cooling shall be initiated via a field setting at the outdoor unit during commissioning or anytime thereafter. Comfort cooling shall allow user to select all or some of the zones on a system to adjust automatically their evaporator temperatures, independent of other zones, based on the impending total loads of that zone determined by using the zone controller temperature sensor.
20. The outdoor unit refrigerant circuit shall employ for safety a threaded fusible plug.
21. Refrigerant Flow Control
 - a. An active refrigerant control and multi section accumulator-receiver that dynamically changes the volume of refrigerant circulating in the system based on operating mode and operating conditions to ensure maximum system performance and efficiency.
 - b. Subcooler: The VRF outdoor unit shall include a factory provided and mounted sub-cooler assembly consisting of a shell and tube-type sub-cooling heat exchanger and EEV providing refrigerant sub-cooling

modulation control by fuzzy logic of EEV and by mode of operation to provide capacity and efficiency as required. Braze plate heat exchangers shall not be allowed for this function.

- c. Smart Load Control: The air source unit shall be provided with Smart Load Control (SLC) enhanced energy saving algorithm that reduces compressor lift during off peak operation. Smart load control operation shall enhance energy savings and increase indoor comfort by monitoring the real time ambient temperature, real time weighted mean average building load, and the outdoor relative humidity (if enabled).

- xix. The SLC algorithm shall be monitoring in real time, the rate of change of the outdoor ambient air temperature, either the outdoor ambient air relative humidity or the indoor air relative humidity [field selectable], and the rate of change of the building load.

- xx. The SLC algorithm shall foresee pending changes in the building load, outdoor temperature and humidity (or indoor humidity) and proactively reset head and/or suction pressure targets in anticipation of the reduction/increase in building load.

- xxi. The SLC algorithm shall provide no fewer than 3 field selection options to maximize the control of the VRF system operation during morning warm-up or cool-down following night-setback reset. The selection shall be set by the commissioning agent (or at any other time thereafter). Selectable algorithm choices include:

- 1. Maximize energy savings

- 2. Balance the rate of temperature change with energy consumed.

- 3. Quickly cool/heat the building.

22. Refrigerant Volume Management

a. Active Refrigerant Charge

- i. The VRF system shall be able to operate at any and all published conditions year round in cooling or heating mode without the need of adding or removing refrigerant from the system.

- ii. The air source unit shall be provided with an isolated vessel to store spare refrigerant and actively pass refrigerant to (or from) the accumulator in real time as necessary to maintain stable refrigeration cycle operation.

- iii. The air source unit microprocessor shall be provided with an algorithm that monitors the VRF system head pressure, suction pressure, subcooling, superheat, compressor speed, high and low side temperatures and the load on the system to adjust the volume of refrigerant actively circulating.

b. Manual Seasonal Refrigerant Charge Adjustments

(Applicable for VRF systems without Active Refrigerant Charge)

- i. Alternates: Systems that CANNOT passively and automatically modify the active refrigerant charge using the method(s) stated to maintain stable cycle operation shall clearly state so in bold capital letters in the proposal. VRF systems that cannot perform active refrigerant control may submit a proposal as an Alternate and must include as part of the equipment price the cost of to provide bi-

annual refrigerant charging services for 15 years. Service shall be performed by the factory authorized agent only. Service shall include refrigerant, parts, labor, and fees necessary to analyze the current state of the system and perform the refrigerant charge adjustment. Service must occur one month before the winter season and one month before the summer season.

- ii. If the VRF system requires a charge adjustment more frequently to maintain stable operation, the VRF manufacturer shall provide additional services at no additional charge.
- iii. The 15 year period shall begin on the date the equipment is commissioned or the date the building occupancy permit was issued for the area(s) served by the system – whichever date is later.
- iv. This service shall be underwritten, warranted, and administered by the VRF equipment manufacturer – not the local distributor or applied representative.
- v. The selected service provider shall be mutually agreeable between the building owner (or owners agent) and must be licensed, insured, and trained to work on the VRF system. No third party service (subcontracted service) providers will be acceptable.
- vi. If the service provider is not an employee of the VRF manufacturer, the service provider shall be reimbursed for services rendered directly from the manufacturer. Labor rate for services shall be paid at the prevailing wage rate in place at the time of service.

23. VRF Systems with Onboard Alternate Operating Mode Selection Capability

- a. All VRF systems which provide field selectable Alternate Operating Modes, for example, High Heat or High Ambient Cooling, published data tables must be available to the public for all modes offered.
- b. Acceptable Alternate Operating Modes must ship with all models of the VRF product offering and must be factory embedded. Custom factory or field modifications to factory provided algorithms created to meet scheduled requirements are not acceptable.
- c. Provide a copy of instructions required to set the Alternate Operation Mode with the initial submittal.
- d. For systems that provide field selectable Alternate Operating Modes, ALL technical data provided in the submittal data sheets showing product rated condition performance data, must also provide separate data sheets that show product performance data at each of the field selectable Alternate Operating Modes available. Capacity, power input, and acoustic performance data for each mode offered shall be reported separately. Mixing of ODU, IDU, or VRF system performance capability operating in one mode with for example the power consumption, sound power rating, or electrical requirements of the same system operating in another mode is not acceptable.

E. Field Supplied Refrigerant Piping Design Parameters

1. The outdoor unit shall be capable of operating at an elevation difference of up to 360 feet above or below the lowest or highest indoor unit respectively without the requirement of field installed subcooler or other forms of performance enhancing booster devices for the Multi V 5 Series, and 164 feet above or 131 feet below for Multi V S Series.
2. The outdoor unit shall be capable of operating with up to 3280 for the Multi V 5 Series and 984 for the Multi V S Series equivalent length feet of interconnecting liquid line refrigerant pipe in the network.
3. The outdoor unit shall be capable of operating with up to 656 actual feet for the Multi V 5 Series and 592 actual feet for the Multi V S Series or 738 equivalent length feet for the Multi V 5 Series and 574 equivalent length feet for the Multi V S Series of liquid line refrigerant pipe spanning between outdoor unit and farthest indoor unit.
4. The piping system shall be designed with pipe expansion and contraction possibilities in mind. Required expansion devices shall be field designed, supplied and installed based on proper evaluation of the proposed piping design. In addition to these requirements, the piping system installation must conform to the VRF equipment manufacturer's published guidelines.
5. The installation of pipe hangers, supports, insulation, and in general the methods chosen to attach the pipe system to the structure must allow for expansion and contraction of the piping system and shall not interfere with that movement.
6. The elevation difference between indoor units on heat pump systems shall be 131 feet for the Multi V 5 Series and 49 feet for the Multi V S Series.
7. The elevation differences for heat pump systems shall be:
 - a. Heat recovery unit to connected indoor unit shall be 49 feet
 - b. Heat recovery unit to heat recovery unit shall be 98 feet
 - c. Indoor unit to indoor unit connected to same heat recovery unit shall be 49 feet
 - d. Indoor unit to indoor unit connected to separate parallel piped heat recovery units shall be 131 feet.
8. The acceptable elevation difference between two series connected heat recovery units shall be 16 feet.

F. Defrost Operations

1. The outdoor unit(s) shall be provided with a minimum of 4 independent field adjustable defrost cycle algorithms to maximize the effectiveness of the defrost cycle to the local weather conditions. Intelligent Defrost shall melt accumulated frost, snow and ice from the outdoor unit heat exchanger. The defrost cycle length and sequence shall be based on outdoor ambient temperatures, outdoor unit heat exchanger temperature, and various differential pressure variables. Intelligent Heating Mode, when outdoor unit humidistat is engaged, shall extend the normal heating sequences by adjusting the outdoor unit coil target temperature to be

- above the ambient dew point temperature delaying the need for defrost operations, so long as heating demand is being met.
2. Smart Heating: This feature shall be capable of eliminating several defrost actions per day based on outdoor air temperature and humidity conditions. Smart heating shall extend the heating operation cycle by delaying the frost formation on the outdoor coil by adjusting the surface temperature to keep it above the current outdoor ambient dew point. The algorithm shall delay while maintaining indoor space temperature.
 3. Defrost Mode Selection: The outdoor unit shall be provided with a minimum of three field selectable defrost operation modes: Normal, Fast, or Forced.
 - a. Normal Defrost: Operation intended for use in areas of the country that experience adverse winter weather with periods of heavy winter precipitation and extremely low temperatures. This strategy shall maximize the systems heating performance and maintain operational efficiency. When the ambient temperature is either: a) above 32°F or b) below 32°F with the humidity level below 60% RH, Intelligent Defrost shall continue heating regardless of ice build-up on the coil until the quality of the heated air (i.e. discharge air temperature) decreases. At temperatures below 4°F, a defrost cycle shall occur every two hours to optimize system heating efficiency.
 - b. Fast Defrost: Operation intended for use in areas of the country with mild winter temperatures and light to moderate humidity levels. The strategy minimizes defrost cycle frequency allowing frozen precipitation to build longer in between cycles. Minimum time between defrost cycles shall be 20 minutes. Intelligent Defrost shall choose between split coil/frame and full system methods based on current weather conditions to minimize energy consumption and maximize heating cycle time.
 - c. Forced Defrost: Operation shall be available for the service provider to test defrost operations at any weather condition and to manually clear frozen water from the outdoor coil surfaces.
 4. Defrost Method Selection: The outdoor unit shall be provided with two field selectable defrost operation methods: Split Coil/Frame and Full System. Split Coil/Frame option provides continuous heating of the occupied space during defrost operation.
 - a. Split Coil/Frame method shall be available when Normal Defrost mode is selected. Split Coil method shall be available on all Heat Pump and Heat recovery single-frame VRF systems. Split Frame defrost shall be available on all Heat Pump and Heat recovery multi-frame outdoor units.
 - b. Split Coil method shall remove ice from the bottom half of the outdoor unit coil first for a maximum time of six minutes, then the top half for a maximum of six minutes. Next the bottom coil shall be heated again for an additional three minutes to remove any frozen water that may have dripped onto the lower coil during the top coil defrost operation.
 - c. When Split Coil/Frame method is selected, a Full System defrost shall occur every 1-9 (field selectable) defrost cycles to assure 100% of the frozen precipitation has been removed to maintain efficient performance.

- d. Full System method shall be available as a field selectable option. All outdoor units located in areas of the country where large volumes of frozen precipitation are common, the commissioning agent shall be able to select the Full System only defrost method.
- 5. Indoor Unit Fan Operation During Defrost
 - a. During partial defrost operation indoor units operating in cooling or dry mode shall continue normal operation.
 - b. During partial defrost operation, indoor units that are commissioned with fans set for continuous operation shall maintain normal fan speed unless the leaving air temperature drops, then the fan speed will be reduced to low speed for the remainder of the defrost cycle.
 - c. During full system defrost operation indoor unit fans will cycle off and remain off during the remainder of the defrost cycle.

G. Oil Management

- 1. The system shall utilize a high pressure oil return system to ensure a consistent film of oil on all moving compressor parts at all points of operation. Oil is returned to compressor through a separate high pressure oil injection pipe directly into the oil sump. Oil returned to the compressor via the suction port of the compressor shall not be allowed.
- 2. Each compressor shall be provided with a high efficiency independent centrifugal cyclone type oil separator, designed to extract oil from the oil/refrigerant gas stream leaving the compressor.
- 3. The system shall have an oil level sensor in the compressor to provide direct oil level sensing data to the main controller. The sensor shall provide data to main outdoor unit PCB to start oil return mode and balance oil levels between multiple compressors.
- 4. The system shall only initiate an oil return cycle if the sensed oil level is below oil level target values as determined by the microprocessor. The system shall display an error if the oil sensor signals low oil level for a period of 130 minutes or longer.
- 5. A default oil return algorithm shall automatically initiate the oil return mode if the system detects a failure of the oil sump sensor. A fault code shall be reported by the system.
- 6. Timed oil return operations or systems that do not directly monitor compressor oil level shall not be permitted.
- 7. Indoor Unit Fan Operation during Oil Return Cycle
 - a. During oil return cycle indoor units operating in cooling or dry mode shall continue normal operation.
 - b. During oil return, indoor units that are commissioned with fans set for continuous operation shall maintain normal fan speed unless the leaving air temperature drops, then the fan speed will be reduced to low speed for the remainder of the oil return cycle.
 - c. During oil return cycle indoor unit fans will cycle off and remain off during oil return cycle while operating in all modes.

H. Fan and Motor Assembly

1. 6 ton frames shall be equipped with one direct drive variable speed propeller fan with Brushless Digitally Controlled (BLDC) motor with a vertical air discharge Heat Pump ARUN024GSS4 unit shall be equipped with one direct drive, variable speed, and axial flow fan with a horizontal air discharge. The motors shall be Brushless Digitally Controlled (BLDC), variable speed, inverter driven motors.
2. 8 to 20 ton frames shall be equipped with two direct drive variable speed propeller fan(s) with BLDC motor(s) with a vertical air discharge. Heat Pump ARUN038GSS4~ARUN060GSS4 and Heat Recovery unit ARUB060GSS4 shall be equipped with two direct drive variable speed axial flow fan(s) with a horizontal air discharge. Each fan shall be provided with an independent dedicated Brushless Digitally Controlled (BLDC), variable speed, inverter driven motors.
3. The fan(s) blades shall be made of Acrylonitrile Butadiene Styrene (ABS) material and incorporate biomimetic technology to enhance fan performance and reduce fan generated noise.
4. The fan(s) motor shall be equipped with permanently lubricated bearings.
5. The fan motor shall be variable speed with an operating speed range of 0-1150 RPM cooling mode and 0-1150 RPM heating mode. The fan assembly(s) shall have a minimum operating speed range from 0 RPM to 850 RPM in cooling mode and heating mode.
6. The fan shall have a guard to help prevent contact with moving parts.
7. The cabinet shall have option to redirect the discharge air direction from vertical to
8. The fan controller shall have a DIP switch setting to raise external static pressure of the fan up to 0.32 inch of W.C. to accommodate ducted installations.
9. The fan control shall have a function setting to remove excess snow automatically.
10. The fan control shall have a function setting to remove access dust and light debris from the outdoor unit and coil.

I. Cabinet

1. Outdoor unit cabinet shall be made of 20 gauge galvanized steel with a weather and corrosion resistant enamel finish. Outdoor unit cabinet finish shall be tested in accordance with ASTM B-117 salt spray surface scratch test (SST) procedure for a minimum of 1000 hours.
2. Cabinet weights and foot prints shall vary between 430 lbs., 7.61 sq. ft. (1.27 sq. ft. per ton), for 6 ton cabinet to 666 lbs., 10.14 sq. ft. (.51 sq. ft. per ton), for 20 ton cabinet for single cabinet configurations. The front panels of the outdoor units shall be removable type for access to internal components.
3. A smaller service access panel, not larger than 7" x 7" and secured by a maximum of (2) screws, shall be provided to access the following
 - a. Service tool connection
 - b. DIP switches
 - c. Auto addressing
 - d. Error codes
 - e. Main microprocessor
 - f. Inverter PCB

4. The cabinet shall have piping knockouts to allow refrigerant piping to be connected at the front, right side, or through the bottom of the unit.
5. The cabinet shall have a factory installed coil guard and shall have a baked enamel finish.

J. Outdoor Unit Coil

1. Outdoor unit coil shall be designed, built and provided by the VRF outdoor unit manufacturer.
2. The outdoor unit coil for each cabinet shall have lanced aluminum fins with a maximum fin spacing of no more than 17 Fins per Inch (FPI). All the outdoor unit coils shall be a 2 or 3 rows consisting of staggered tubes for efficient air flow across the heat exchanger.
3. Outdoor unit coil shall be comprised of aluminum fins mechanically bonded to copper tubing with inner surfaces having a riffling treatment to expand the total surface of the tube interior
4. The aluminum fin heat transfer surfaces shall have factory applied corrosion resistant Black Fin coating. The copper tubes shall have inner riffling to expand the total surface of the tube interior.
 - a. ISO 21207 Salt Spray Test Method B – 1500 hours
 - b. ASTM B-117 Acid Salt Test – 900 hours
 - c. The Black Fin coating shall be certified by Underwriters Laboratories and per ISO 21207. The above conditions shall establish the minimum allowable performance which all alternates must comply.
5. Variable Path Heat Exchanger: System shall have a variable flow and path outdoor heat exchanger function to vary the refrigerant flow and volume and path. Control of the variable path circuits shall be based on system operating mode and operating conditions as targeted to manage the efficiency and minimize or maximize the circulating volume of the operating fluids of the system. This feature allows MV 5 to maintain system head pressure that delivers “gas-furnace leaving air temperature” from the indoor unit at moderate and low ambient outdoor air temperatures. The outdoor unit coil, all indoor units and pipe network shall be field tested to a minimum pressure of 550 psig.

K. Compressor(s)

1. Compressor shall be designed and assembled by the VRF manufacturer specifically for use in the air source VRF product line. Third party manufactured, branded, or designed to the VRF system’s OEM specifications by a third party manufacturer shall not be acceptable.
2. Compressor shall be a hermetic, high-side shell (HSS), commercial grade, compliant scroll direct-drive design.
 - a. Compressor Design: The compressor design shall be of the high pressure shell scroll type where the internal pressure below the suction valves of the compressor shall be at the same high pressure and high temperature. The motor shall be cooled by high pressure gas at temperatures above saturation conditions and minimize the mixing of refrigerant liquid with oil in the sump. The system shall employ a high pressure oil return method returning recovered oil from the oil separator directly into the oil sump of the compressor; oil shall not be allowed to return via the suction line. Bearing surfaces are continually coated with oil. The

- compressor shall employ an Aero-bearing constructed with high lubricity materials increasing operation time in case of low sump oil level. Compressor shall have a nominal operating range from 12Hz to 150 Hz.
3. The fixed and oscillating compressor scroll components shall be made of high grade (GC25) or denser steel material. All scrolls shall be heat treated and tempered.
 4. The oscillating scroll shall be finely machined and polished. PVE refrigerant oil shall be used as the sole liquid used to maintain a seal between the high and low sides of the compression chamber. Compressors that requires the use of any type of mechanical or wearable sealant material between the moving surfaces of the compression chamber is NOT ACCEPTABLE.
 5. Vapor Injection: System shall have a medium pressure gas vapor injection function employed in the heating and cooling modes to increase system capacity when the outdoor ambient temperatures are low and lower compressor lift when temperatures are high. The compressor vapor injection flow amount shall be controlled by the vapor injection sub-cooling algorithm reset by discharge gas temperatures of the compressor.
 6. Bearing surfaces shall be coated with Teflon® equal. Bearings shall be lubricated using a constant flow of PVE refrigerant oil to the bearing surfaces The film of oil separating the crankshaft journals and bearing surfaces shall be consistent at all times the crankshaft is in motion and shall be maintained irrelevant of crankshaft rotational speed.
 7. An internal, integrated, mechanically driven gear pump shall draw oil from the compressor sump reservoir, pressurize the oil and inject the oil directly to the crankshaft journals maintaining a consistent film of oil between all moving parts. Auxiliary, indirect, or electronically driven pumps are not acceptable.
 8. The viscosity property of the PVE oil in the compressor sump shall be maintained irrelevant or compressor operation and the surrounding ambient temperature.
 - a. The compressor shall be equipped with an external thermally protected electric crankcase heater that is automatically activated only when the ambient temperature is below freezing and the compressor is not running to maintain the temperature of the oil in the sump above the refrigerant boiling point.
 - b. During stable operation, irrelevant of ambient air temperature outside the water source unit, the temperature of refrigerant vapor in contact with the surface of the oil in the compressor sump shall be maintained above 140°F to prevent foaming and to eliminate refrigerant from mixing with the oil degrading the viscosity of the oil in the sump.
 - c. Low side shell (LSS) type compressors that use suction vapor to cool the compressor motor shall not be acceptable.
 9. The compressor motor shall be designed to operate at high temperatures.
 - a. The motor winding insulation shall be designed to operate continuously at a minimum temperature of 180°F without deterioration.
 - b. The motor cooling system shall be designed to maintain acceptable operational temperature at all times and in all conditions using high pressure, hot refrigerant vapor as motor coolant.

- c. Low side shell and compressors that use low pressure, low temperature refrigerant gas to cool the motor are not acceptable.
10. Inverter Compressor Controller(s)
- a. Each compressor shall be equipped with a dedicated inverter compressor drive. The control of multiple compressors using a single drive is not acceptable.
 - b. The inverter drive shall vary the speed of the compressor crankshaft between zero (0) Hz and 140 Hz.
 - c. The inverter driver controller shall be matched with the physical properties of the compressor. The drive shall be manufactured by the VRF air source unit manufacturer. The inverter drive and matching compressor shall have been thoroughly tested as a matched pair. The inverter drive shall be programmed to avoid operating the compressor at any speed that results in harmonic vibration, nuisance noise, or mechanical damage to either the driver or the compressor with power provided that is within the tolerance specification.
 - d. The compressor inverter drive assembly and software must be designed, manufactured, and supplied by the VRF product manufacturer. Third party branded inverter driver hardware and/or driver software or inverter driver hardware and/or software provided by a third party manufacturer to meet OEM specifications of the VRF water source manufacturer will not be acceptable.
 - e. All inverter drive hardware or software manufactured in, is a product of, or sourced from China, or using a broker or third party provider as an intermediary that obtains the product from CHINA shall not be acceptable.
11. Compressor(s)
- a. Each 6, 8, 10 ton frames shall be equipped with a single hermetically sealed, inverter driven, High Side Shell (HSS) scroll compressor.
 - b. 12, 14, 16, 18 and 20 ton frames shall be equipped with dual hermetically sealed, inverter driven, High Side Shell (HSS) scroll compressors.
 - c. Each inverter driven, HSS scroll compressor shall be capable of operating from 12 Hz up to 150 Hz in any and all modes (cooling, heating or simultaneous modes).
 - d. The compressor shall be designed for a separate port for oil to be directly returned to the compressor oil sump.
 - e. The compressor bearing(s) shall have Teflon™ coating and shall be an aero type design using High lubricity materials.
 - f. The compressor(s) shall be protected with:
 - i. High Pressure switch
 - ii. Over-current /under current protection
 - iii. Oil sump sensor
 - iv. Phase failure
 - v. Phase reversal

- vi. Compressor shall be capable of receiving injection of medium pressure gas at a point in the compression cycle where such injection shall allow a greater mass flow of refrigerant at lower outdoor ambient and achieving a higher heating capability. The VRF outdoor unit shall have published performance data for heating mode operation down to -13°F on both heat pump and heat recovery systems.
 - g. Standard, non-inverter driven compressors shall not be permitted nor shall a compressor without vapor injection or direct sump oil return capabilities.
- 12. Heat Pump models:
 - a. The compressor shall be a high efficiency high-side shell rotary hermetic design. Bearing shall be manufactured using high lubricity material. Compressor shall be factory charged with Polyvinyl Ether (PVE) oil. Single or dual speed compressors charged with Polyolester oil (POE) shall not be acceptable. Compressor inverter drive shall allow modulation from 20Hz to 90Hz with control in 1.0 Hz increments depending on the nominal capacity. (ARUN060GSS4) The compressor shall be a high-side shell hermetic scroll design. Oil sump area and chamber housing the motor shall be operated at the same temperature and pressure of the gas leaving the compressor chamber to ensure that the low temperature low pressure refrigerant returning to the compressor does not mix with the oil in the sump. Bearing shall be manufactured using high lubricity material. Compressor shall be factory charged with Polyvinyl Ether (PVE) oil. Single or dual speed compressors charged with Polyolester oil (POE) oil shall not be acceptable. Compressor motor shall be designed to operate at a frequency range of 0Hz to 160Hz. Compressor inverter drive shall allow modulation from 12Hz to 110Hz.
- 13. Heat Recovery model:
 - a. The compressor design shall be of the high pressure shell scroll type where the internal pressure below the suction valves of the compressor shall be at the same high pressure and high temperature. The motor shall be cooled by high pressure gas at temperatures above saturation conditions and minimize the mixing of refrigerant liquid with oil in the sump. The system shall employ a high pressure oil return method returning recovered oil from the oil separator directly into the oil sump of the compressor; oil shall not be allowed to return via the suction line. Bearing surfaces are continually coated with oil. The compressor shall employ an Aero-bearing constructed with high lubricity materials increasing operation time in case of low sump oil level. Compressor shall have a nominal operating range from 12Hz to 110 Hz.
- L. Operational Sound Levels
 - 1. Each single frame outdoor unit shall be rated with an operational sound pressure level not to exceed as listed on below chart when tested in an anechoic chamber under ISO 3745 standard at the highest field selectable heating operating modes available. Such documentation shall be presented in all submittals, manufactures who elect to rate their equipment at other than tested in an anechoic chamber under ISO 3745 standard at the highest field selectable heating operating modes available and the highest field selectable conditions shall not be allowed.

2. A field setting shall be available to program the outdoor unit to reduce sound levels at night, when desired, to a selectable level while still able to meet building load requirement. This mode is available in both cooling and heating modes.
- M. Sensors
1. Each outdoor unit module shall have:
 - a. Suction temperature sensor
 - b. Discharge temperature sensor
 - c. Oil level sensor
 - d. High Pressure sensor
 - e. Low Pressure sensor
 - f. Outdoor temperature sensor
 - g. Outdoor humidity sensor
 - h. Outdoor unit heat exchanger temperature sensors
- N. Wind Load Installations for Outdoor Units
1. LG FL Wind load Installation Drawings meet the requirements of the 2017 Florida Building Code, 6th Edition and ASCE Standard 7-2010.
- O. Seismic Installations
1. Provide OSHPD Special Seismic Certification Preapproval (OSP) documents for certified product list of VRF equipment to be installed in high seismic risk areas. Provide LG supplemental installation documents in conformance with CBC 2013, 2016 and 2019 California Building Code and IBC 2012, 2015 and 2018 International Building Code.
- P. Warranty
1. Limited Warranty Period
 - a. STANDARD ONE-YEAR PARTS WARRANTY FOR A QUALIFIED SYSTEM - The Part(s) of a qualified System, including the compressor, are warranted for a period (the "Standard Parts Warranty Period") ending on the earlier to occur of one (1) year after the date of original installation, or eighteen (18) months from the date of manufacture.
 - b. ADDITIONAL SIX (6) YEAR COMPRESSOR PART WARRANTY - The Compressor is warranted for an additional six (6) year period after the end of the applicable Standard Part Warranty Period (the "Compressor Warranty Period").
 2. Extended Warranty
 - a. The Standard Warranty Period and the Compressor Warranty Period are extended to a total of ten (10) years (the "Extended Warranty Period") for qualified Systems that have been (a) commissioned by a party that has completed the current Training Requirements, (b) such commissioning is pursuant to LG's current published instructions, and (c) the System commissioning results and supporting documents are entered correctly into LG's online commissioning system. Commissioning of a System requires one (1) hour of LG Monitoring View (LGMV) data. Commissioning results must be entered into LG's online commissioning system within sixty (60) days of System startup.

2.2 EEV KIT (If applicable)

A. General

1. Unit shall be manufactured by LG.
2. Unit shall be factory assembled and wired unit shall be designed to be installed indoors only, when installed outdoors provide NEMA weatherproof enclosure.
3. Unit shall be capable to be installed with heat pump or heat recovery VRF system.
4. Unit requires one communication kit to provide power and control signals.
5. Connects liquid line piping from outdoor unit to any AHU coil.

B. Electrical

1. Six conductor, 18 GA shielded and stranded field supplied wiring for 12 volt (low voltage) power and control signal from communication kit.

2.3 AHU COMMUNICATION KIT PAHCMR00 (RETURN AIR CONTROL) (If applicable)

A. General

1. Unit shall be manufactured by LG.
2. Unit shall be factory assembled and wired.
3. Unit shall be designed to be installed for indoor or outdoor.
4. Unit shall be capable to be installed with heat pump or heat recovery VRF system.
5. Allows communication between third party air handling unit (AHU) and LG Multi V air-source or water-source outdoor units with combination ratio between 50% to 100%.
6. Requires one EEV kit to control the flow of refrigerant from Multi V outdoor unit to AHU coil.

B. Electrical:

1. The unit electrical power shall be 230/1/60 (V/Ph/Hz).

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230255

SECTION 230265

VARIABLE REFRIGERANT FLOW INDOOR UNITS

PART 1 – GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 SYSTEM DESCRIPTION

- A. Indoor units are matched with heat pump or heat recovery VRF (variable refrigerant flow) outdoor unit.

1.2 DELIVERY, STORAGE AND HANDLING

- A. Units shall be stored and handled per unit manufacturer's recommendations.

PART 2 – PRODUCTS

2.1 CEILING CASSETTE – 4 WAY

A. General

1. Unit shall be manufactured by LG.
2. Unit shall be designed to be installed for indoor application.
3. Unit shall be designed to mount recessed in the ceiling and has a surface mounted grille on the bottom of the unit.
4. The unit shall be available in both nominal 2' x 2' and 3' x 3' chassis.

B. Casing/Panel

1. Unit case shall be manufactured using galvanized steel plate.
2. The unit panel shall be provided with an off-white or black Acrylonitrile Butadiene Styrene (ABS) polymeric resin grille.
3. The grille shall have a tapered trim edge, and a hinged, spring clip (screw-less) return air filter-grille door.
4. Unit shall be provided with metal ears designed to support the unit weight on four
5. Ears shall have pre-punched holes designed to accept field supplied all thread rod hangers.
6. Unit shall be supplied with snap off access panels to facilitate leveling of unit without removing the grille.

C. Cabinet Assembly

1. Unit shall have four supply air outlets and one return air inlet.

2. The supply air outlet shall be through four directional slot diffusers each equipped with independent oscillating motorized guide vanes designed to change the airflow direction.
3. The grille shall have a discharge range of motion of 40° in an up/down direction with capabilities of locking the vanes.
4. The unit shall have a guide vane algorithm designed to sequentially change the predominant discharge airflow direction in counterclockwise pattern.
5. Guide vanes shall provide airflow in all directions.
6. Unit shall be equipped with factory installed temperature thermistors for:
 - a. Return air
 - b. Refrigerant entering coil
 - c. Refrigerant leaving coil
7. Unit shall have a factory assembled, piped and wired electronic expansion valve (EEV) for refrigerant control.
8. Unit shall have a built-in control panel to communicate with other indoor units and to the outdoor unit.
9. The unit shall have factory designated branch duct knockouts on the unit case.
10. The unit shall have provision of fresh air ventilation through a knock-out on the cabinet.
11. The branch duct knockouts shall have the ability to duct up to 1/2 the unit airflow capacity.
12. The branch duct cannot be ducted to another room.
13. Unit shall have the following functions as standard:
 - a. Self-diagnostic function
 - b. Auto addressing
 - c. Auto restart function
 - d. Auto changeover function (Heat Recovery system only)
 - e. Auto operation function
 - f. Child lock function
 - g. Forced operation
 - h. Dual thermistor control
 - i. Sleep mode
 - j. Dual set point control
 - k. Multiple aux heater applications
 - l. Filter life timer
 - m. External on/off input
 - n. Wi-Fi compatible
 - o. Auto fan operation
 - p. Leak detection logic

D. Fan Assembly

1. The unit shall have a single, direct-drive turbo fan made of high strength ABS HT-700 polymeric resin.
2. The fan impeller shall be statically and dynamically balanced.
3. The fan motor is Brushless Digitally commutated (BLDC) with permanently lubricated and sealed ball bearings.
4. The fan motor shall include thermal, overcurrent and low RPM protection.
5. The fan/motor assembly shall be mounted on vibration attenuating rubber grommets.
6. The fan speed shall be controlled using microprocessor based direct digitally controlled algorithm that provides a minimum of four pre-programed fan speeds in the heating mode and fan only mode and five speeds in the cooling mode. The fan speed algorithm provides a field selectable fixed speed.
7. A field setting shall be provided to vary air throw pattern to compensate for high ceiling installations.
8. In cooling mode, the indoor fan shall have the following settings: Low, Med, High, Super high, Power Cool, and Auto.
9. In heating mode, the indoor fan shall have the following settings: Low, Med, High, Super high and Auto.
10. Unit shall have factory installed motorized louver to provide flow of air in up and down direction for uniform airflow.

E. Filter Assembly

1. The return air inlet shall have a factory supplied removable, washable filter.
2. The unit shall have the capability to accept a field provided MERV 1 to MERV 10 filter.
3. The filter access shall be from the bottom of the unit without the need for tools.
4. The nominal 3'x3' cabinet unit shall have provision for an optional auto-elevating grille kit designed to provide motorized ascent/descent of the return air grille/pre filter assembly.
 - a. The ascent/descent of the return air grille shall be up to a distance of 14-3/4 feet allowing access to remove and clean the filter.
 - b. The auto-elevating grille shall have a control algorithm to accept up, down and stop control commands from the controller.
 - c. The auto-elevating grille shall have a control to stop the descent automatically if a contact is made with any obstacle.

F. Coil Assembly

1. Unit shall have a factory built coil comprised of aluminum fins mechanically bonded on copper tubing.
2. The copper tubing shall have inner grooves to expand the refrigerant contact surface for high efficiency heat exchanger operation.
3. Unit shall have a minimum one or two row coil 18-19 fins per inch.

4. Unit shall have a factory supplied condensate drain pan below the coil constructed of EPS (expandable polystyrene resin).
5. Unit shall include an installed and wired condensate drain lift pump capable of providing minimum 27.5 inch lift from bottom surface of the unit.
6. The drain pump shall have a safety switch to shut off the unit if condensate rises too high in the drain pan.
7. Unit shall have provision of 45° flare refrigerant pipe connections.
8. The coil shall be factory pressure tested at a minimum of 550 psig.
9. All refrigerant piping from outdoor unit to indoor unit shall be field insulated. Each pipe should be insulated separately. Thickness and heat transfer characteristics shall be determined by the design engineer and shall meet all code requirements.

G. Microprocessor Control

1. The unit shall have a factory installed microprocessor controller capable of performing functions necessary to operate the system.
2. The unit shall be able to communicate with other indoor units and the outdoor unit using a field supplied minimum of 18 AWG, two core, stranded, twisted and shielded communication cable.
3. The unit controls shall operate the indoor unit using one of the five operating modes:
 - a. Auto changeover (Heat Recovery System only)
 - b. Heating
 - c. Cooling
 - d. Dry
 - e. Fan only
4. The unit shall be able to operate in either cooling or heating mode for testing and/or commissioning.
5. The unit shall be able to operate with the fan turned off during system cooling thermal off.
6. The unit shall have adjustable, multi-step cooling and heating mode thermal on/off temperature range settings.
7. The system shall include a product check function to access and display indoor unit type and capacity from a wired programmable thermostat controller.
8. Unit shall have a field settable method to choose auto fan speed change operation based on mode of operation, on/off fan operation based on mode of operation, or continuous minimum set fan speed operation.

H. Electrical

1. The unit electrical power shall be 208-230/1/60 (V/Ph/Hz).
2. The unit shall be capable of operating within voltage limits of +/- 10% of the rated voltage.

- I. Controls: Unit shall use controls provided by the manufacturer to perform all functions necessary to operate the system effectively and efficiently and communicate with the outdoor unit over an RS-485 daisy chain.
- J. Seismic Installations: Provide OSHPD Special Seismic Certification Preapproval (OSP) documents for certified product list of VRF equipment to be installed in high seismic risk areas. Provide LG supplemental installation documents in conformance with CBC 2013, 2016 and 2019 California Building Code and IBC 2012, 2015 and 2018 International Building Code.
- K. Warranty: Please refer to the respective outdoor unit for applicable warranty.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230265

SECTION 230280

VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION

- A. This specification is to cover a complete Variable Frequency motor Drive (VFD) consisting of a pulse width modulated (PWM) inverter designed for use with a standard NEMA Design B induction motor.
- B. The drive manufacturer shall supply the drive and all necessary options as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of twenty years. VFD's that are manufactured by a third party and "brand labeled" shall not be acceptable. All VFDs installed on this project shall be from the same manufacturer.

1.2 QUALITY ASSURANCE

A. Referenced Standards

- 1. Institute of Electrical and Electronic Engineers (IEEE)
 - a. Standard 519-1992, IEEE Guide for Harmonic Content and Control.
- 2. Underwriters laboratories
 - a. UL508C
- 3. National Electrical Manufacturer's Association (NEMA)
 - a. ICS 7.0, AC Adjustable Speed Drives
- 4. IEC 16800 Parts 1 and 2
- 5. National Electric Code (NEC)
 - a. NEC 430.120, Adjustable-Speed Drive Systems
- 6. International Building Code (IBC)
 - a. IBC 2006 Seismic – referencing ASC 7-05 and ICC AC-156

B. Qualifications

- 1. VFDs and options shall be UL listed as a complete assembly. VFD's that require the customer to supply external fuses for the VFD to be UL listed are not acceptable. VFDs with red label UL stickers, requiring additional branch circuit protection are not acceptable. The base VFD shall be UL listed for 100 KAIC without the need for input fuses.

2. CE Mark – The VFD shall conform to the European Union ElectroMagnetic Compatibility directive, a requirement for CE marking. The VFD shall meet product standard EN 61800-3 for the First Environment restricted level.
3. The entire VFD enclosure, including the bypass shall be seismically certified and labeled as such in accordance with the 2006 International Building Code (IBC):
 - a. VFD manufacturer shall provide Seismic Certification and Installation requirements at time of submittal.
 - b. Seismic importance factor of 1.5 rating is required, and shall be based upon actual shake test data as defined by ICC AC-156.
 - c. Seismic ratings based upon calculations alone are not acceptable. Certification of Seismic rating must be based on testing done in all three axis of motion.
4. Acceptable Manufactures
 - a. ABB ACH Series.
 - b. Alternate manufacturer's requests must be submitted in writing to the Engineer for approval at least 20 working days prior to bid. Approval does not relieve the supplier of specification requirements.
5. The VFD manufacturer shall have available a comprehensive, HVAC Drive Computer Based Training (CBT) product. The CBT product shall include detailed, interactive sections covering VFD unpacking, proper mechanical and electrical installation, and programming. The CBT product shall allow the user to provide just-in-time training to new personnel or refresher training for maintenance and repair personnel on the user's site. The CBT product shall be repeatable, precise and shall include record keeping capability. The CBT product shall record answers to simulations and tests by student ID number. The CBT product must be professionally produced and have interactive sections, student tests, and include video clips of proper wiring and installation.

1.3 SUBMITTALS

- A. Submittals shall include the following information:
 1. Outline dimensions, conduit entry locations and weight.
 2. Customer connection and power wiring diagrams.
 3. Complete technical product description include a complete list of options provided. Any portions of this specification not meet must be clearly indicated or the supplier and contractor shall be liable to provide all additional components required to meet this specification.
 4. Compliance to IEEE 519 – harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).

- a. The VFD manufacturer shall provide calculations; specific to this installation, showing total harmonic voltage distortion is less than 5%. Input filters shall be sized and provided as required by the VFD manufacturer to ensure compliance with IEEE standard 519. All VFD's shall include a minimum of 5% impedance reactors, **no exceptions**.

PART 2 - PRODUCTS

2.1 VARIABLE FREQUENCY DRIVES

- A. The VFD package as specified herein shall be enclosed in a UL Listed Type enclosure, exceeding NEMA enclosure design criteria (enclosures with only NEMA ratings are not acceptable), completely assembled and tested by the manufacturer in an ISO9001 facility. The VFD tolerated voltage window shall allow the VFD to operate from a line of +30% nominal, and -35% nominal voltage as a minimum.
 1. Environmental operating conditions: VFDs shall be capable of continuous operation at 0 to 50° C (32 to 122° F) ambient temperature as per VFD manufacturers documented/submittal data or VFD must be oversized to meet these temperature requirements. Not acceptable are VFD's that can only operate at 40° C intermittently (average during a 24 hour period) and therefore must be oversized. Altitude 0 to 3300 feet above sea level, less than 95% humidity, non-condensing. All circuit boards shall have conformal coating.
 2. Enclosure shall be rated UL Type 1 and shall be UL listed as a plenum rated VFD. VFD's without these ratings are not acceptable. NEMA only type 1 enclosures are not acceptable (must be UL Type 1).
 3. Provide NEMA 3R enclosures where exposed to outside weather or wet conditions.
- B. All VFDs shall have the following standard features:
 1. All VFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating. The keypad shall be removable, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFDs.
 2. The keypad shall include Hand-Off-Auto selections and manual speed control. The drive shall incorporate "bumpless transfer" of speed reference when switching between "Hand" and "Auto" modes. There shall be fault reset and "Help" buttons on the keypad. The Help button shall include "on-line" assistance for programming and troubleshooting.
 3. There shall be a built-in time clock in the VFD keypad. The clock shall have a battery backup with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. If the battery fails, the VFD shall automatically revert to hours of operation since initial power up. Capacitor back-up is not acceptable. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets

and output Form-C relays. The VFD shall have a digital input that allows an override to the time clock (when in the off mode) for a programmable time frame. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings.

4. The VFD's shall utilize pre-programmed application macros specifically designed to facilitate start-up. The Application Macros shall provide one command to reprogram all parameters and customer interfaces for a particular application to reduce programming time. The VFD shall have two user macros to allow the end-user to create and save custom settings.
5. The VFD shall have cooling fans that are designed for easy replacement. The fans shall be designed for replacement without requiring removing the VFD from the wall or removal of circuit boards. The VFD cooling fans shall operate only when required. To extend the fan and bearing operating life, the VFD shall cycle the cooling fans on and off as required.
6. The VFD shall be capable of starting into a coasting load (forward or reverse) up to full speed and accelerate or decelerate to set point without tripping or component damage (flying start).
7. The VFD shall have the ability to automatically restart after an over-current, over-voltage, under-voltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between attempts shall be programmable.
8. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430.250 for 4-pole motors.
9. The VFD shall have internal 5% impedance reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 5% impedance may be from dual (positive and negative DC bus) reactors, or 5% AC line reactors. VFD's with only one DC reactor shall add an AC line reactor.
10. The input current rating of the VFD shall be no more than 3% greater than the output current rating. VFD's with higher input current ratings require the upstream wiring, protection devices, and source transformers to be oversized per NEC 430.120. Input and output current ratings must be shown on the VFD nameplate.
11. The VFD shall include a coordinated AC transient surge protection system consisting of 4-120 joule rated MOV's (phase to phase and phase to ground), a capacitor clamp, and 5% impedance reactors.
12. The VFD shall provide a programmable loss-of-load (broken belt / broken coupling) Form-C relay output. The drive shall be programmable to signal the loss-of-load condition via a keypad warning, Form-C relay output, and / or over the serial communications bus. The loss-of-load condition sensing algorithm shall include a programmable time delay that will allow for motor acceleration from zero speed without signaling a false loss-of-load condition.

13. The VFD shall have user programmable underload and overload curve functions to allow user defined indications of broken belt or mechanical failure / jam condition causing motor overload
14. The VFD shall include multiple “two zone” PID algorithms that allow the VFD to maintain PID control from two separate feedback signals (4-20mA, 0-10V, and / or serial communications). The two zone control PID algorithm will control motor speed based on a minimum, maximum, or average of the two feedback signals. All of the VFD PID controllers shall include the ability for “two zone” control.
15. If the input reference (4-20mA or 2-10V) is lost, the VFD shall give the user the option of either (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the VFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, Form-C relay output and / or over the serial communication bus.
16. The VFD shall have programmable “Sleep” and “Wake up” functions to allow the drive to be started and stopped from the level of a process feedback signal.
17. Provide drive with circuit breaker option and remote panel mounting kit.

C. All VFDs to have the following adjustments:

1. Three (3) programmable critical frequency lockout ranges to prevent the VFD from operating the load continuously at an unstable speed. The lockout range must be fully adjustable, from 0 to full speed.
2. Two (2) PID Set point controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the VFD, using the microprocessor in the VFD for the closed-loop control. The VFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID set point shall be adjustable from the VFD keypad, analog inputs, or over the communications bus. There shall be two independent parameter sets for the PID controller and the capability to switch between the parameter sets via a digital input, serial communications or from the keypad. The independent parameter sets are typically used for night setback, switching between summer and winter set points, etc.
3. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain the set point of an independent process (i.e. valves, dampers, etc.). All set points, process variables, etc. to be accessible from the serial communication network.
4. Two (2) programmable analog inputs shall accept current or voltage signals.
5. Two (2) programmable analog outputs (0-20ma or 4-20 ma). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, Active Feedback, and other data.

6. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices. All digital inputs shall be programmable to initiate upon an application or removal of 24VDC or 24VAC.
7. Three (3) programmable, digital Form-C relay outputs. The relay outputs shall include programmable on and off delay times and adjustable hysteresis. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating of 2 amps RMS. Outputs shall be true Form-C type contacts; open collector outputs are not acceptable.
8. Run permissive circuit - There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, input contact closure, time-clock control, or serial communications), the VFD shall provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to a VFD digital input and allows VFD motor operation. Two separate safety interlock inputs shall be provided. When either safety is opened, the motor shall be commanded to coast to stop and the damper shall be commanded to close. The keypad shall display "start enable 1 (or 2) missing". The safety input status shall also be transmitted over the serial communications bus.
9. The VFD control shall include a programmable time delay for VFD start and a keypad indication that this time delay is active. A Form C relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates. The time delay shall be field programmable from 0 – 120 seconds. Start delay shall be active regardless of the start command source (keypad command, input contact closure, time-clock control, or serial communications), and when switching from drive to bypass.
10. Seven (7) programmable preset speeds.
11. Two independently adjustable accel and decel ramps with 1 – 1800 seconds adjustable time ramps.
12. The VFD shall include a motor flux optimization circuit that will automatically reduce applied motor voltage to the motor to optimize energy consumption and reduce audible motor noise. The VFD shall have selectable software for optimization of motor noise, energy consumption, and motor speed control.
13. The VFD shall include a carrier frequency control circuit that reduces the carrier frequency based on actual VFD temperature that allows higher carrier frequency settings without derating the VFD.
14. The VFD shall include password protection against parameter changes.

- D. The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable). All VFD faults shall be displayed in English words. The keypad shall include a minimum of 14 assistants including:
1. Start-up assistant
 2. Parameter assistants
 - a. PID assistant
 - b. Reference assistant
 - c. I/O assistant
 - d. Serial communications assistant
 - e. Option module assistant
 - f. Panel display assistant
 - g. Low noise set-up assistant
 - h. Maintenance assistant
 - i. Troubleshooting assistant
 - j. Drive optimizer assistants
- E. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times. The display shall be in complete English words (alpha-numeric codes are not acceptable):
1. Output Frequency
 2. Motor Speed (RPM, %, or Engineering units)
 3. Motor Current
 4. Motor Torque
 5. Motor Power (kW)
 6. DC Bus Voltage
 7. Output Voltage
- F. The VFD shall include a fireman's override input. Upon receipt of a contact closure from the fire / smoke control station, the VFD shall operate in one of two modes: 1) Operate at a programmed predetermined fixed speed ranging from -500Hz (reverse) to 500Hz (forward). 2) Operate in a specific fireman's override PID algorithm that automatically adjusts motor speed based on override set point and feedback. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands), except customer defined safety run interlocks, and force the motor to run in one of the two modes above. "Override Mode" shall be displayed on the keypad. Upon removal of the override signal, the VFD shall resume normal operation, without the need to cycle the normal digital input run command.
- G. Serial Communications
1. The VFD shall have an EIA-485 port as standard. The standard protocols shall be Modbus, Johnson Controls N2, Siemens Building Technologies FLN, and BACnet. Optional protocols for LonWorks, Profibus, EtherNet, BACnet IP, and DeviceNet shall be available. Protocol provided shall match ATC system in Building. Each individual drive shall have the protocol in the base VFD. The use of third party gateways and multiplexers is not acceptable. All protocols shall be "certified" by the governing authority (i.e. BTL Listing for BACnet). Use of non-certified protocols is not allowed.

2. The BACnet connection shall be an EIA-485, MS/TP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC). The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC including, but not limited to:
 - a. Data Sharing – Read Property – B.
 - b. Data Sharing – Write Property – B.
 - c. Device Management – Dynamic Device Binding (Who-Is; I-Am).
 - d. Device Management – Dynamic Object Binding (Who-Has; I-Have).
 - e. Device Management – Communication Control – B.
3. If additional hardware is required to obtain the BACnet interface, the VFD manufacturer shall supply one BACnet gateway per drive. Multiple VFDs sharing one gateway shall not be acceptable.
4. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible.
5. Serial communication in bypass shall include, but not be limited to; bypass run-stop control, the ability to force the unit to bypass, and the ability to lock and unlock the keypad. The bypass shall have the capability of allowing the DDC to monitor feedback such as, current (in amps), kilowatt hours (resettable), operating hours (resettable), and bypass logic board temperature. The DDC shall also be capable of monitoring the bypass relay output status, and all digital input status. All bypass diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote bypass fault reset shall be possible.
6. The VFD / bypass shall allow the DDC to control the drive and bypass digital and analog outputs via the serial interface. This control shall be independent of any VFD function. The analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive and bypass' digital (Form-C relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive and bypass' digital inputs shall be capable of being monitored by the DDC system. This allows for remote monitoring of which (of up to 4) safeties are open.

7. The VFD shall include an independent PID loop for customer use. The independent PID loop may be used for cooling tower bypass valve control, chilled water valve / hot water valve control, etc. Both the VFD PID control loop and the independent PID control loop shall continue functioning even if the serial communications connection is lost. As default, the VFD shall keep the last good set point command and last good DO & AO commands in memory in the event the serial communications connection is lost and continue controlling the process.
- H. EMI / RFI filters. All VFD's shall include EMI/RFI filters. The onboard filters shall allow the VFD assembly to be CE Marked and the VFD shall meet product standard EN 61800-3 for the First Environment restricted level with up to 100 feet of motor cable. No Exceptions. Certified test reports shall be provided with the submittals confirming compliance to EN 61800-3, First Environment.
- I. All VFD's through 75HP at 480 V shall be protected from input and output power mis-wiring. The VFD shall sense this condition and display an alarm on the keypad. The VFD shall not sustain damage from this power mis-wiring condition.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be the responsibility of the mechanical contractor. The contractor shall install the drive in accordance with the recommendations of the VFD manufacturer as outlined in the VFD installation manual.
- B. Power wiring shall be completed by the electrical contractor, to NEC code 430.122 wiring requirements based on the VFD input current. Caution: VFDs supplied without internal reactors have substantially higher input current ratings, which may require larger input power wiring and branch circuit protection. The contractor shall complete all wiring in accordance with the recommendations of the VFD manufacturer as outlined in the installation manual.

3.2 START-UP

- A. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the owner, and a copy kept on file at the manufacturer.

3.3 PRODUCT SUPPORT

- A. Factory trained application engineering and service personnel that are thoroughly familiar with the VFD products offered shall be locally available at both the specifying and installation locations. A toll free 24/365 technical support line shall be available.
- B. A computer based training CD or 8-hour professionally generated video (VCR format) shall be provided to the owner at the time of project closeout. The training shall include installation, programming and operation of the VFD, bypass and serial communication.

3.4 WARRANTY

- A. The VFD Product Warranty shall be 24 months from the date of certified start-up, not to exceed 30 months from the date of shipment. The warranty shall include all parts, labor, travel time and expenses. A toll free 24/365 technical support line shall be available.

END OF SECTION 230280

SECTION 230290

DUCT MOUNTED COILS

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

PART 2 - PRODUCTS

2.1 DUCT MOUNTED COILS

- A. Coils as manufactured by Carrier shall be with aluminum plate fins, have collars drawn, belled, and firmly bonded to copper tubes by mechanical expansion of tubes. No soldering or tinning used in the bonding process.
- B. Coils have galvanized steel casing and are mounted pitched in the unit casing. Coils are to be removable in duct flanges.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230290

SECTION 230300

FANS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

PART 2 - PRODUCTS

2.1 FANS

- A. Furnish and install fans of the type, models, size and capacity indicated on the Drawings. Models indicated are as manufactured by Carnes Company. ACME or Greenheck, with equivalent characteristics will be considered.
- B. Refer to Drawing schedule for required accessories and related appurtenances.

2.2 ROOF EXHAUST FANS

- A. All roof exhaust fans shall be centrifugal roof exhausters of aluminum rustproof construction.
- B. Units shall be direct connected with full ball-bearing motor. Power unit shall be isolated against vibration by means of oil resistant rubber or spring steel mounting.
- C. Provide square insulated curb cap of aluminum with aluminum liner as an integral part of the unit. Each unit shall be equipped with a back draft or automatic damper, disconnect switch for the motor, and birdscreens.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230300

SECTION 230310

HOT WATER CABINET HEATERS

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

PART 2 - PRODUCTS

2.1 HOT WATER CABINET HEATERS

- A. Furnish and install where indicated on the Drawings hot water cabinet heaters as manufactured by Sterling Co. of model, capacity and performance noted on the Drawing schedule.
- B. The cabinet shall be 16 gauge steel, four side overlap front panels, with M-shaped stiffener running entire panel length as standard. Integral, louvered air inlet and outlet, insulated over entire coil section.
- C. Front panel removed with two tamperproof screws and shall be of finish as selected by Architect. Unit to be equipped with factory mounted fan cycling thermostat. Fans are forwardly curved double-inlet centrifugal of aluminum construction and are modular in design.
- D. The water coil is constructed of copper tubing mechanically expanded into aluminum fins. All joints are brazed with high temperature silver alloy. Water coils have a plugged drain tube and vent tube extended into the unit end compartment. Automatic air vent fittings shall be provided. Coils are field reversible.
- E. Filters are removable by removing front panel. 1" woven glass filters standard to be used.
- F. Provide factory finished trim flange for all semi-recessed applications.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

3.3 CLEANING

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230310

SECTION 230400

SHEETMETAL WORK AND RELATED ACCESSORIES

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements shall govern work in this section. Submit shop drawings for checking and approval.

PART 2 - PRODUCTS

2.1 SHEETMETAL DUCTWORK

- A. Contractor shall furnish and install all sheet-metal ducts as shown on the Drawings. While the Drawings shall be adhered to as closely as possible, the Engineer reserves the right to vary the run and size to meet the field conditions. Any duct size not shown shall be sized in proportion to the air carried at the same resistance in similar ductwork, or of size as directed.
- B. All ductwork shall be constructed of galvanized steel gauges in accordance with the latest edition of the ASHRAE/SMACNA Guide. Bracing angles for ductwork shall be hot dipped galvanized for steel ductwork and appropriate gauge for aluminum ductwork. All ducts 18" and over in width shall be cross broken to prevent flutter.
- C. Ducts shall be braced as follows:
 - 1. All ducts not exceeding 24" on one side shall be assembled with airtight slip joints.
 - 2. 25" to 40" larger dimension 1" x 1" x 1/8" angles.
 - 3. 41" to 60" larger dimension 1-1/2" x 1-1/2" x 1/8" angles.
 - 4. All bracing angles shall be a minimum of 4' apart along the length of the duct.
 - 5. Furnish and install all angles and frames for all registers, diffusers, grilles and louvers.
 - 6. Support horizontal ducts with hangers spaced not more than 8' apart. Place hangers at all changes in direction. Use strap hangers for cuts up to 30" wide.
- D. Comply with all State and Local regulations regarding fire stopping and fireproofing. Provide fusible link fire dampers as required by State, local and Underwriter authorities and where indicated on the Drawings. Each fire damper shall be installed in such a manner as to permit ready access for inspection and maintenance purposes.
- E. Provide splitter and butterfly dampers, deflecting vanes for control of air volume and direction and for balancing systems, where indicated, specified, directed and as required for the proper operation of the systems. Dampers shall be of the same material as the duct, at least one gauge heavier than the duct, reinforced where indicating quadrant and locking device for adjusting damper and locking in position.

- F. Where ducts fewer than 100 square inches penetrate a rated wall, steel ductwork system of a minimum 0.0127 inch thickness shall be used.
- G. All elbows shall have a minimum center line radius of 150% of duct width. If the radius is smaller, turning vanes shall be used: Turning vanes shall be double thickness, fitted into slide strips and screwed or riveted to duct below.
- H. Contractor shall furnish and install all access doors in ducts as required. Access doors shall be of the pan type 1" thick and shall be provided with two galvanized hinges and suitable latched. Access doors insulated with same thickness material as duct and shall be double casing construction.

2.2 REGISTERS AND DIFFUSERS

- A. Registers and diffusers shall be installed where shown on the Drawings and shall be of the sizes specified and the type indicated on the drawing schedule.
- B. All registers and diffusers shall be installed in accordance with manufacturer's recommendations.
- C. Registers and diffusers shall be as manufactured by Anemostat Co., Carnes or Hart and Cooley.

2.3 UNDERGROUND DUCT WORK

A. Quality Assurance

- 1. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- 2. Acceptable Manufacturers: BlueDuct by AQC Industries, Shoreview MN, 55126, (877-783-1520). www.aqcind.com and e-mail: team@aqcind.com

A. Underground Duct System

- 1. Complete duct system (including: plenums, round duct, run-outs, diffuser boots, etc.) must be from one manufacturer and be of the same material, construction and connection method throughout. Field made duct components are NOT acceptable.
- 2. Include the complete underground duct system including plenums and diffuser boots.
- 3. Unless otherwise noted, all duct and fittings shall be constructed per SMACNA's Duct Construction Standards (+10 w.g.).
- 4. Provide elbows, duct, diffusers, plenum, clamp & gasket, boots, saddle registers, caulk, water gauge test and adapters as required by drawings for underground installation.

5. Ductwork shall be HDPE, closed cell plastic material that is recyclable, does not emit volatile organic compounds, and conforms to ASTM-D2412. Ductwork shall be resistant to mildew, mold (UL 181B), and radon gas (BSS 7239-88). Ductwork shall not rust or crack under external stress or strain. Ductwork shall have R-10 thermal insulation value without the use of external insulation.
6. All joints shall be gasket and sealed. Clamps and gaskets shall be used on ductwork without flanges. Clamps shall be polyethylene with 410 stainless steel plates and stainless steel screws. Gaskets shall comprise of ¼" thick butyl rubber sealant tape with silver polyester facing that is water and UV resistant and shall not stain. Gaskets shall comply with ASTM-E84 for flame and smoke spread.
7. Flanged joints and duct branches shall use a co-polymer adhesive caulking sealant that is water and UV resistant. Flanges shall be connected with stainless steel bolts.
8. Assembled ductwork shall be able to maintain +/- 10" static pressure with no leakage.
9. Assembled ductwork shall be approved for installations 48" below flood plain elevation without water intrusion.
10. Duct system installed by manufacture trained installer will be an air and water tight system.
11. Fiberglass style ductwork or PVC coated galvanized steel ductwork shall NOT be acceptable.
12. Duct system performance shall exceed SMACNA's Leakage Class 3 requirements at the system design static pressure.
13. Duct system shall carry a 10 year warranty. 10 year warranty is contingent on the installing contractor's field installation crew being installation certified by AQC.

C. Installation

1. Follow manufacturer's installation instructions. 10 Year Manufacturer's warranty requires all installing contractors to be certified by AQC Industries prior to installation.
2. Excavate a trench evenly as per The Blue Duct Installation Manual. No bedding is required except for cases of bedrock or clay where sand or light aggregate may be used.
3. Backfill material may consist of pea gravel, sand or excavated material, if equivalent. Backfill should not contain particles larger than 3/4 inch.
4. Hand tamp backfill material to hold in place. Do not allow heavy loads to travel over backfilled duct, as crushing may occur.

5. Duct assembly per The Blue Duct Installation manual:
 - a. Cut piping material with circular or reciprocating
 - b. For ducts 18" and smaller, apply gaskets & clamps for duct assembly.
 - c. For ducts 20" and larger, apply bolts & sealant.
 - d. For take-offs, saddles, plenums or diffuser boots, apply sealant and screws.
6. Only AQC approved and supplied materials may be used.

B. Testing

1. Complete underground duct system shall be tested for leakage after final assembly.
2. Follow SMACNA air duct leakage test standard.
3. Allow 24 hours after final assembly for the sealants to cure before testing the duct system.

- C. Cleaning: Remove dust and debris from ductwork prior to occupancy.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230400

SECTION 230410

PIPING, FITTINGS, VALVES AND NOTES (HOT WATER)

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements shall govern work in this section. Submit shop drawings for checking and approval.

1.1 PIPING NOTES

- A. The Contractor shall erect all pipe, fittings, valves, hangers, anchors, expansion joints and all accessories specified, indicated on the Drawings or required to assure proper operation of all piping systems installed under this Contract. All piping shall be maintained at a proper level to assure satisfactory operation, venting and drainage. Piping and valves in any locality where possible shall be grouped neatly and shall be run so as to avoid reducing headroom or passage clearance.
- B. All piping shall be new and of the material and weight specified under various services. Steel and wrought iron pipe 2" and larger shall be seamless or lap welded. All piping shall have the maker's name and brand rolled on each length of pipe.
- C. All piping, fittings, valves and strainers shall be cleaned of grease, dirt and scale before installation. All temporary pipe openings shall be kept closed during the performance of the work. The ends of all piping shall be reamed smooth and all burrs removed before installation.
- D. All piping shall be cut accurately to measurements taken on the job. Offset connections shall be installed alignment of vertical to horizontal piping and where required to make a true connection and to provide for expansion. Bent or sprung pipe shall not be installed where shown on Drawings and where necessary to provide for expansion of piping. Cold spring hot lines one-half estimated distance of maximum expansion. Suitable pipe anchors shall be installed where shown or required.
- E. Piping connections shall have unions where necessary for replacement and repair of equipment. Gate valves and controls valves shall be installed where shown and where necessary for proper operation and service.
- F. Vertical piping shall be plumb and horizontal piping shall be parallel to walls and partitions. Piping shall be supported as required to prevent the transmission of noise and vibration.
- G. Work shall include all pipe, fittings, offsets and requirements for the installation of piping of other work including ducts and conduit. Reducing fittings shall be used where pipe changes size. All piping shall be installed with ample clearance to center accurately in sleeves through floors, and walls and partitions.

- H. Piping shall be downgraded to drain connections at low points and upgraded to vent connections at high points unless otherwise noted. Drain connections shall be valved and piped to a floor drain. Vent connections on mains shall be equipped with air vent valves fitted with a copper tube drip line extended to a drain outlet. Vent connections on branches and equipment shall be fitted with key type manual vent cocks.
- I. Drain piping shall be installed from all equipment as required. The Contractor shall extend drain piping and turn down over floor drains.

PART 2 - PRODUCTS

2.1 PIPING (ABOVEGROUND)

- A. Pipe/Grooved (Standard): Carbon Steel, A-53B/A-106B - Roll or cut grooved-ends as appropriate to pipe material, wall thickness, pressures, size and method of joining. Pipe ends to be grooved in accordance with current listed standards conforming to ANSI/AWWA C-606.
- B. Victaulic Mechanical Couplings for Joining Carbon Steel Pipe
- C. Standard Mechanical Couplings, 2 inch (DN50) through 12 inch (DN300): Manufactured in two segments of cast ductile iron, conforming to ASTM A-536, Grade 65-45-12. Gaskets shall be pressure-responsive synthetic rubber, grade to suit the intended service, conforming to ASTM D-2000. Mechanical Coupling bolts shall be zinc plated (ASTM B-633) heat treated carbon steel track head conforming to ASTM A-449 and ASTM A-183, minimum tensile strength 110,000 psi (758450 kPa) as provided standard.
- D. Rigid Type: Coupling housings with offsetting, angle-pattern bolt pads shall be used to provide system rigidity and support and hanging in accordance with ANSI B31.1, B31.9, and NFPA 13.
 - 1. 2" (DN50) through 8" (DN200): Installation ready rigid coupling for direct stab installation without field disassembly. Gasket shall be Grade "EHP" EPDM compound with red color code designed for operating temperatures from -30 deg F (-34 deg C) to +250 deg F (+120 deg C).
 - 2. Flexible Type: Use in locations where vibration attenuation and stress relief are required. Flexible couplings may be used in lieu of flexible connectors at equipment connections. Three couplings, for each connector, shall be placed in close proximity to the vibration source.
 - 3. 2" (DN50) through 8" (DN200): Installation ready flexible coupling for direct stab installation without field disassembly. Gasket shall be Grade "EHP" EPDM compound with red color code designed for operating temperatures from -30 deg F (-34 deg C) to +250 deg F (+120 deg C).
 - 4. Flange Adapters: For use with grooved end pipe and fittings, flat faced, for mating to ANSI Class 125 / 150 flanges.
 - 5. Grooved couplings shall meet the requirements of ASTM F- 1476.

6. Gasket: Synthetic rubber conforming to steel pipe outside diameter and coupling housing, manufactured of elastomers as designated in ASTM D-2000.
 - a. Reference shall always be made to the latest published Selection Guide for Victaulic Gaskets for proper gasket selection for the intended service.

E. Grooved End Fittings

1. Standard fittings shall be cast of ductile iron conforming to ASTM A-536, Grade 65-45-12, forged steel conforming to ASTM A-234, Grade WPB 0.375" wall (9, 53 mm wall), or fabricated from Std. Wt. Carbon Steel pipe conforming to ASTM A-53, Type F, E or S, Grade B. Fittings provided with an alkyd enamel finish or hot dip galvanized to ASTM A-153. Zinc electroplated fittings and couplings conform to ASTM B633.
2. AGS Fittings shall be supplied with factory AGS grooved ends, for use with Victaulic W07 or W77 couplings and W741 flange adapter. Fittings shall be manufactured of ductile iron conforming to ASTM A-536, forged carbon steel conforming to ASTM A-234, or factory fabricated from carbon steel pipe conforming to ASTM A-53. Fittings shall be manufactured to the dimensional standards ASME B16.9. Orange enamel coated or galvanized.
3. Hole-Cut Branch Outlets
 - a. Bolted Branch Outlet: Branch reductions on 2"(DN50) through 8"(DN200) header piping. Bolted branch outlets shall be manufactured from ductile iron conforming to ASTM A-536, Grade 65-45-12, with synthetic rubber gasket, and heat treated carbon steel zinc plated bolts and nuts conforming to physical properties of ASTM A-183.
 - b. Strapless Outlet: 1/2"(DN15) or 3/4"(DN20) NPT outlet on 4" (DN100) and larger header sizes rated for 300 PSI (2065 kPa).
 - c. Strapless Thermometer Outlet: To accommodate industrial glass bulb thermometers with standard 1-1/4"-18 NEF 2B extra fine thread and 6" (152mm) nominal bulb length on 4" (DN100) and larger header sizes rated for 300 PSI (2065 kPa).

F. Grooved End Valves

1. Butterfly Valves
 - a. 2"(DN50) through 12"(DN300) Sizes: 300 psi CWP (2065 kPa) suitable for bidirectional and dead-end service at full rated pressure. Body shall be grooved end black enamel coated ductile iron conforming to ASTM A536. Disc shall be electroless nickel plated ductile iron with blowout proof 416 stainless steel stem. Disc shall be offset from the stem centerline to allow full 360 degree seating. Seat shall be pressure responsive Lubricated Nitrile. Valve bearings shall be TFE lined fiberglass, and stem seals shall

be of the same grade elastomer as the valve seat. Valve shall be complete with ISO flange for actuation mounting. Valve operators shall be lever handle or gear operator, available with memory stop feature, locking device, chainwheel. (Valve with EPDM seat is UL classified in accordance with ANSI/NSF-61.)

G. Check Valves

1. 2"(DN50) through 3"(DN80) Sizes Spring Assisted: Black enamel coated ductile iron body, ASTM A-536, Grade 65-45-12, stainless steel non-slam tilting disc, stainless steel spring and brass shaft, nickel-plated seat surface, 365 psi (2517 kPa). Victaulic Series 716H.
2. 4"(DN100) through 12"(DN300) Sizes Spring Assisted: Black enamel coated ductile iron body, ASTM A-536, Grade 65-45-12, elastomer encapsulated ductile iron disc suitable for intended service, stainless steel spring and shaft, welded-in nickel seat, 300 psi (2065 kPa). Victaulic Series 716.
3. 2"(DN50) through 4"(DN100) Sizes Horizontal Swing: Horizontal installation, ductile iron body, ASTM A-536, Grade 65-45-12, and Type 316 stainless steel clapper. Synthetic rubber bumper & bonnet seals suitable for intended service, stainless steel wetted parts, 300 psi (2065 kPa). Victaulic Series 712.
4. 4"(DN100) through 12"(DN300) Sizes Venturi Check: Black enamel coated ductile iron body, ASTM A-536, Grade 65-45-12 with venturi-like taps, elastomer encapsulated ductile iron disc suitable for intended service, stainless steel spring and shaft, welded-in nickel seat, 300 psi (2065 kPa). Victaulic Series 779.

H. Tri-Service Valve Assembly: Combination shut-off, throttling and non-slam check valve.

1. 2-1/2"(DN65) through 12"(DN300) Sizes: Vic®-300 MasterSeal™ butterfly valve with memory stop feature assembled with Series 716 (2-1/2" & 3") (DN65 & DN75) or Style 779 Venturi Check (4" – 12") (DN100-DN300). Series 779 check valve with venturi like taps for flow measurement. Working pressures to 300 psi (2065 kPa).
- I. Ball Valves: 1-1/2"(DN40) through 6"(DN150) sizes, ASTM A-536, Grade 65-45-12, ductile iron body, chrome plated carbon steel ball and stem, TFE seats, with Fluoroelastomer seals. 800 psi (5515 kPa).
- J. Plug Valves: 3"(DN75) through 12"(DN300) sizes, with memory stop for throttling, metering or balancing service. Unidirectional bubble-tight shut-off, bi-directional sealing optional. Ductile iron body, bonnet and plug, ASTM A-536, Grade 65-45-12. Plug encapsulated with synthetic rubber suitable for intended service. Welded-in nickel seat, stainless steel self-lubricating bearings. 175 PSI (1200 kPa). AWWA

rigid groove dimensions may be adapted to IPS sized system through the use of Victaulic Style 307 transition couplings.

- K. Circuit Balancing Valves
 - J. 2"(DN50) and Smaller Sizes: 300 psi (2065 kPa), y-pattern, globe type with soldered or threaded ends, non-ferrous Ametal® brass copper alloy body, EPDM o-ring seals. 4-turn digital readout handwheel for balancing, hidden memory feature with locking tamper-proof setting, and connections for portable differential meter. Victaulic / TA Hydronics Series 786 or 787 STAD.
 - K. Install Series 78U union port fitting and Series 78Y strainer/ball valve combination to complete terminal hookup at coil outlet. Install Series 793 differential pressure controller to stabilize differential pressure and ensure stable and accurate modulating control. Ametal® brass copper alloy body, bonnet, cone and spindles, threaded ends only.
 - L. 2-1/2"(DN65) and Larger Sizes: 300 psi (2065 kPa), y-pattern, globe type with flanged or grooved ends, ASTM A536 ductile iron body, all other metal parts of Ametal® brass copper alloy, EPDM O-ring seals. 8, 12 or 16-turn digital readout handwheel for balancing, hidden memory feature with locking tamper-proof setting, and connections for portable differential meter. Victaulic / TA Hydronics Series 788 or 789 STAG.
- L. Differential Pressure Controller: For use in conjunction with TA Balancing valves to stabilize differential pressure and ensure stable and accurate modulating control. Ductile iron or Ametal body, Ametal® brass copper alloy bonnet, cone and spindles, flanged ends only.
- M. Grooved End Specialties
 - 1. Expansion Joints
 - a. 2"(DN50) through 6"(DN150) Sizes: Packless, gasketed, type with grooved end telescoping body, suitable for axial end movement to 3". 350 psi (2410 kPa). Victaulic Style 150 Mover®.
 - b. 3/4"(DN20) and Larger Sizes: Expansion joint consisting of a series of grooved end nipples joined with flexible-type couplings. Joint movement and expansion capabilities determined by number of couplings / nipples used in the joint. Victaulic Style 155.
 - 2. Dielectric Waterways: 1"(DN25) through 8"(DN200) sizes, grooved, plain end, or threaded end, ASTM A-53 carbon steel or ASTM A-536 ductile iron body, zinc electroplated, with LTHS high temperature stabilized polyolefin polymer liner. Victaulic Style 47.

3. Strainers - Grooved-End

- a. Y-Type Strainer. 2"(DN50) through 18"(DN450) sizes, 300 PSI (2065 kPa) Y-Type Strainer shall consist of ductile iron body, ASTM A-536, Grade 65-45-12, Type 304 stainless steel perforated metal removable baskets with 1/16" (1,6mm) diameter perforations 2"-3" (DN50-DN75) strainer sizes, 1/8" (3,2mm) diameter perforations 4"-12" (DN100-DN300) strainer sizes, and 0.156" (4mm) diameter perforations 14" -18" (DN350-DN450) strainer sizes. Victaulic Style 732 and W732.

N. Tooling:

Tools shall be manufactured and supplied by coupling manufacturer. Use roll sets or cut groovers compatible with the pipe material and wall thickness per manufacturer's installation instructions.

O. Piping installed under this Section of the Specifications shall be in accordance with the following schedule.

- 1. All steel piping, except where indicated differently, (i.e. underground piping) shall be standard weight black steel pipe Schedule 40, Grade A53, black steel. Pipe 2" and smaller, cast iron screwed fittings. Pipe 2-1/2" and larger, steel welding fittings. Pipe and fittings as manufactured by National, Wheeling, Bethlehem or equal, manufactured in accordance with ASTM current edition. All pipes must be reamed before installation.
- 2. Where the Contractor elects to use copper piping, it shall be rigid Type "L" copper, Chase, Anaconda or approved equal. Fittings shall be wrought copper, Nibco, Anaconda, Mueller or approved equal. Where copper piping is used, make all additional provisions for expansion. All condensate piping shall be Type "M" copper, rigid, full size of unit drain tapping, or larger as shown on Drawings.
- 3. All drainage pipe lines, 2" larger except where galvanized screw pipe is shown on the Drawings or specified hereafter, shall be extra heavy cast iron soil pipe and fittings.

P. Piping installation shall be arranged for draining through accessible valves at low points.

Q. Threaded short and close nipples shall be Schedule 80, extra heavy weight of the same material as pipe in system in which they are installed.

R. All bare copper pipe, tubing and fittings shall be cleaned with steel wool and all excess solder shall be removed.

2.3 VALVES

A. All valves, unless specified or noted otherwise, shall be designed for a working pressure of not less than 200 p.s.i. water or 125 p.s.i. steam with name and pressure rating of valve cast in body. All valves shall be of the same manufacturer, unless specified otherwise. Valves for cut-off shall be gate valves, unless otherwise specified.

B. All valves of same manufacturer: similar to Jenkins Bros., Walworth, Kennedy or approved equal.

- C. Four inch and larger, flanged; smaller sizes, screwed.
- D. All Gate and Globe valves shall be installed with handle in an upright position.
- E. The Contractor shall furnish and install all valves shown on Drawings and all valves that are necessary for proper operation and maintenance of systems and equipment. All piping connections to each piece of equipment and all branch connections to mains shall have cut-off valves.
- F. The following schedule of valves for hot water, etc. is based on Jenkins Brothers, Inc. catalog numbers (except as noted); equivalent Lukenheimer, Walworth, O-I-C, Crane Fairbanks Company valves will be acceptable.
- G. Ball Valves
 - 1. 1/4" to 2-1/2" rated for 600 p.s.i wog, with brass body, chrome plated brass ball, virgin PTFE seats and full port with threaded or solder connections.
 - 2. 2-1/2" and larger rated for 200 p.s.i with carbon steel body, stainless steel full port ball, RTFE seats, lever operated to 4" gear operated 6" and above, with flanged end connections.
- H. Gate Valves
 - 1. Up to 2" : Bronze gate solid wedge, inside screw traveling stem union bonnet, - Fig. 47U
 - 2. 2-1/2" and 3" : Iron body, bronze-mounted gate, solid wedge, OS&Y rising stem, - Fig. 650-A
 - 3. 4" and larger: Iron body, bronze-mounted gate, solid wedge, OS&Y rising stem, - Fig. 651-A
- I. Globe Valves
 - 1. Up to 2" : Bronze body, regrinding seat ring and plug, union bonnet, -Fig. 546P
 - 2. 2-1/2" and 3" : Iron body, bronze-mounted globe and angle, regrinding disc and seat ring, OS&Y -Fig. 613
 - 3. All gate valves 6" and larger: Fitted 3/4" by-pass globe valve.
- J. Plug Valves
 - 1. Up to 2" : Lubricated, semi-steel short pattern wrench operated, -Fig. 142
 - 2. 2-1/2" and larger: Lubricated, semi-steel short pattern wrench operated, -Fig. 143
 - 3. Similar to Rockwell Mgd. Co., Jenkins, Kennedy or approved equal.

K. Butterfly Valves used for hot water shall be the following:

1. 2-1/2" to 12" rated for 175 p.s.i bubble tight close off, 14" and larger for 150 p.s.i close-off.
2. Full lug cast iron body, aluminum bronze disc, stainless steel stem EPDM peroxide cured seat.
3. 2-14" to 6" valves to be equipped with 10 position notch plate and lever lock handle.
4. On installation, valves to be in full open position when flange bolts are tightened and stem in a horizontal position except when equipped with a chain-wheel gear operator.
5. Provide chain wheel gear operator on all valves installed 7 feet or higher.
6. Valves to be designed with replaceable seat and parts kits.
7. Valve to be Bray series 31, Dezurik 637 or Demco.

L. Check Valves

1. 150 p.s.i. WSP class.
2. Up to 2" : Bronze, regrinding bronze disc, screw-in cap, -Fig. 762A
3. 2-1/2" and 3" : Iron body, bronze mounted regrinding bronze seat ring and disc, - Fig. 623
4. 4" and larger: Iron body, bronze mounted regrinding bronze seat ring and disc, - Fig. 624

M. Drain Valves: All low points shall have drain valves, with hose ends. Where 1/2" and 3/4" sizes are indicated, "Standard" hose end drain valves shall be used. Provide brass hose end drain caps at each drain valve. Where larger than 3/4" drains are shown, gate valve shall be used. Provide brass nipples and reducer from drain valve size to 3/4" terminating with 3/4" hose end drain valve and cap.

2.4 FITTINGS

A. Nipples

1. All nipples shall have clean cut threads and shall be made from new pipe, standard weight for all lengths, except that close and shoulder nipples shall be extra heavy.
2. Fittings - 2-1/2 and Smaller: All fittings shall be standard weight steam pattern gray cast iron, Grinnell, Stockholm or equal approved.
3. Fittings - 3" and Larger: The Contractor has the option to use screwed, flanged or welded fittings so long as all ASME requirements are met.

B. Joints and Unions

1. Threaded joints shall be full and clean cut. The ends of pipe shall be reamed to the full inside diameter, all burrs shall be removed and no more than three threads shall be exposed beyond fittings when made up. Joints shall be made up tight with graphite base pipe joint compound. Exposed threads of ferrous pipe shall be painted with acid-resisting paint after caulking, lampwick or other material will be allowed for correction of defective joints.
2. Flange joints shall be made up perfectly square and tight. Screwed flanges and loose flanges shall be cast iron and welding flanges shall be steel. Flanges shall be faced true and bolted up tight with 1/16" Carlock ring type gasket.
3. Bolts shall be high quality steel with hexagon nuts and heads. The Contractor shall apply grease to threads of bolt.
4. Welded joints in piping shall be by the electric or oxyacetylene process using welding rods if the characteristics similar to pipe material and as recommended by the pipe manufacturer and shall be done in accordance with the ASME Code for pressure piping. Welding shall be done by qualified welders under the requirements of the ASME Boiler and Pressure Vessel Code.
5. The pipe lengths shall be aligned with welding rings and the abutting pipe ends shall be concentric. Prior to welding, the groove and adjacent surfaces shall be thoroughly cleaned of all grease, scale or rust. During welding, all slag, or flux remaining on the bead shall be removed before laying down the next bead. The welding metal shall be thoroughly fused with the base metal at all sections of the weld. Short lengths of pipe may be beveled on the job with oxyacetylene torch, provided all scale and oxides are removed.
6. Joints shall be butt-welded, single V-type. All fittings shall be steel welding fittings. Elbows and fittings formed with coupling or welded cut pipe sections shall not be acceptable.
7. Bonney Weldolets or welding saddles may be used for branch connections, which are less than one-half the size of the main to which they connect.
8. Ground Joint Unions, Flange Connections, Reaming & Filling Ground joint unions shall be 200 lb. s.w.p. for brass. Flanges shall be 150 lb. s.w.p. for brass, 125 lb. s.w.p. for cast iron.
9. Ground joint unions of flanges shall be used only on exposed accessible piping. Where concealed, right and left nipples and couplings must be used. Where flanged connections are used, full size gaskets must be inserted.

- C. Threads: Shall be standard, clean cut and tapered. All piping shall be reamed free from burrs. All piping shall be kept free of scale and dirt. Caulking of threads will not be permitted. All piping shall be threaded and made up in accordance with the current edition of the ASA Standard Specifications for pipe threads.

D. Unions

1. Unions for use on ferrous pipe 2" and smaller shall be malleable iron with brass to iron ground joint spherical seat and threaded connections. Unions 2 1/2" and over shall be flanged type with gasket.
2. Unions for copper tubing shall be cast bronze conforming to ASA B16. The Contractor shall furnish adapters where required for copper pipe.
3. Where copper pipe connects to ferrous pipe or metals, the Contractor shall furnish EPCO isolating type dielectric unions. Plastic type isolating bushings are not acceptable.
4. Unions shall be installed wherever necessary for repair or replacement of equipment, valves, strainers, etc. Final connections to equipment shall be made in a manner that will permit removal without cutting of pipelines.

E. Solder

1. All sweat joints shall be made up with lead and antimony free solder.
2. Solder shall be Oatey SilverFlo or approved equal. Flux shall be non-toxic and non-corrosive.
3. All copper tubing ends shall be reamed, filed and cleared of burrs and rough edges. All pipes shall be reamed after cutting and threading.

F. Expansion

1. The entire piping installation shall be installed with adequate provision for expansion. No rigid connections will be permitted.
2. Branches shall be of sufficient length and have 3 elbow swings to allow for pipe expansion.
3. Provide expansion joints, guides and anchors equal to "Flexonics" Type HCF where indicated on Drawings or where necessary for proper expansion compensation. Submit shop drawing.
4. Any breaks in the piping within the guarantee period due to improper provision for expansion must be replaced at the expense of this Contractor, and the conditions corrected to prevent future recurrence.
5. Any damages to surrounding areas and equipment due to this failure shall also be repaired and paid for at the expense of the Contractor.
6. Joints to have 150 psi rating, ANSI-B16.5 with liner and cover.

2.5 PIPING SLEEVES

- A. Furnish sleeves built into place for all piping passing through walls, floors or building construction. Sleeves, not less than 1/2" larger in diameter than piping and its covering, if any, and extending full depth of construction pierced. Pack sleeves through walls/floors in accordance with Underwriters' Requirements.
- B. Sleeves piercing exterior walls, integral waterproofed walls shall be standard weight steel piping. Furnish welded center flange buried in construction for sleeves through exterior walls below grade. At exterior walls, make pipes watertight in sleeves with oakum packing and caulked lead joints on both sides of wall. All other sleeves: Galvanized sheet steel with lockseam joints, #22 USSG for 3" or under. Sleeves for piping 4" and larger, #18 USSG.
- C. Pipes passing through interior membrane waterproofed floors, cast iron flashing sleeve, with integral flashing flange and clamping ring, similar to Josam Series #1880. Adjust sleeves to floor construction with steel or wrought iron pipe nipples top and bottom, extending 3" above finished floor. Burn & J.R. Smith are equal.
- D. Pipes passing through membrane waterproofed walls, cast iron flashing sleeve with internal flashing flange and clamping ring similar to Josam Series #1870. Make pipes watertight in sleeves with oakum packing and caulked lead joints. Burn & J.R. Smith are equal.
- E. For flashing sleeves specified in Pars. C and D, lead flashing extended at least 10" around flashing sleeves, securely held in place by clamping device.

2.6 PIPING ENCLOSURES

- A. Where concealed piping in ceilings and wall of finished spaces is not possible vertical or horizontal metal piping enclosures equal to "Sterling" model PCH (horizontal) or PCHV (vertical). Provide all required hangers, supports, corners, brackets, etc. color per Architect.

PART 3 - EXECUTION

3.1 GENERAL NOTES - PIPING NOTES, DRAINING, VENTING AND MISCELLANEOUS WATER SPECIALTIES

- A. Piping shall be installed as indicated on Drawings. Elevations and dimensions are indicated as a guide only and are subject to change with actual job conditions.
- B. Except for drainage piping, which shall pitch down with flow, mains shall pitch upward or be installed dead level as indicated. Horizontal runs shall be parallel to walls.
- C. In general, all branch connections shall be top of bottom 45 degree or 90 degree, pitching up or down from mains.
- D. Where indicated, flexible connectors shall be installed. All final connections to equipment, pumps, units, etc. shall have companion flanged, flange unions or ground joint unions. (125 lbs.)

- E. All piping shall be adequately supported with approved type hangers so as to prevent absolutely any sagging of lines, or any undue strain on pipes or fittings. All pipe lines shall be capped during construction to prevent entry of dirt or other foreign material. All piping lines after erection shall be blown or flushed out to render the piping system as clean as possible before system water is added for operation.
- F. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.
- G. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- H. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.2 DRAINING

- A. All low points shall have drain valves with hose ends. Where 1/2" and 3/4" sizes are indicated, "Standard" hose end drain valves shall be used. Provide brass hose end drain caps at each drain valve. Where larger than 3/4" drains are shown, gate valve shall be used. Provide brass nipple and reducer from drain valve size to 3/4" terminating with 3/4" hose end drain valve and cap.

3.3 VENTING

- A. All high points in piping shall be vented automatically with float vents. At all high points of piping, whether specifically indicated or not, provide Maid-o-Mist or B&G No. 7 or 27 Air Eliminators with shut off cock, auxiliary key vent and copper tubing overflow carried to floor along wall as indicated or directed.

3.4 WATER SPECIALTIES

- A. Air Vents: Install at all high points automatic air vents to eliminate air binding. All automatic air vents shall be approved heavy duty type equipped with petcocks and tubing for manual venting. All vents installed in coils, etc. shall be of manual key operated type. All vents concealed from view shall be accessible through access doors. Vents shall be by Hoffman, Anderson or Bell & Gossett, 125 psig rated.
- B. Pressure Gauge: Furnish and install pressure gauges on suction and discharge sides of each pump and as required to check operation of equipment; pressure gauges shall have 4-1/2" diameter dials, Ashton, Ashcroft or approved equal.

- C. Install thermometers at all locations in piping system as noted on Drawings and as required to check system performance. Thermometers shall be installed at the supply and return of coils and 3-way diverting valves as manufactured by Trerice, Weksler or Moeller, with 4-1/2 inch face, cast aluminum case, chrome plated steel ring, white background with black embossed markings, glass window, stainless steel pointer, brass movement, 316 stainless steel bulb. Provide separable, universal angle sockets for all thermometers.

END OF SECTION 230410

SECTION 230420

SUPPORTS, SLEEVES AND PLATES

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

- A. This Contractor shall furnish and install all plates, hangers and supports for his equipment including piping, headers, fans expansion tank, ductwork, etc.
- B. All ductwork, piping and equipment shall be hung or supported from structural members only.

PART 2 - PRODUCTS

2.1 PIPING, DUCTWORK AND EQUIPMENT

- A. All piping shall be supported from building structure in a neat and workmanlike manner wherever possible, parallel runs of horizontal piping shall be grouped together on trapeze hangers. Vertical risers shall be supported at each floor line with steel pipe clamps. Use of wire perforated metal to support pipes will not be permitted. Hanging pipes from other pipes will not be permitted.
- B. Necessary structural members, hangers and supports of approved design to keep piping in proper alignment and prevent transmission of injurious thrusts and vibrations shall be furnished and installed. In all cases where hangers, brackets, etc., are supported from concrete construction, care shall be taken not to weaken concrete or penetrate waterproofing.
- C. All hangers and supports shall be capable of screw adjustment after piping is erected. Hangers supporting piping expanding into loops, bends and offsets shall be secured to the building structure in such a manner that horizontal adjustment perpendicular to the run of piping supported may be made to accommodate displacement due to expansion. All such hangers shall be finally adjusted, both in the vertical and horizontal direction, when the supported piping is hot.
- D. Pipe hangers shall be as manufactured by Grinnell, whose catalog numbers are given herein, or equivalent Carpenter and Paterson, or F&S Mfg. Co.
- E. Piping shall be supported as follows unless otherwise indicated on the Drawings:
 - 1. Heating piping shall be 1-1/2 " and smaller Fig. #260 adjustable clevis hanger. 2" and larger Fig. #174 one-rod swivel roll hanger.
 - 2. Two-rod hangers shall be used for piping close to the ceiling slab or where conditions prohibit use of other hanger types.

3. Anchors for hanger rods shall be Phillips "Red Head" self-drilling type. Anchors shall be placed only in vertical surfaces.
 4. Spacing of pipe supports shall not exceed 8 feet for pipes up to 1-1/2" and 10 feet on all other piping.
 5. Hangers shall pass around insulation and a 16 gauge steel protective cradle; 12" long shall be inserted between hangers and insulation. Insulation under cradle shall be high density calcium silicate or approved equal to prevent crushing.
 6. All piping shall be supported to allow free movement where expanding or contracting. Pipe shall be anchored as required or directed.
 7. All lateral runs of piping shall be securely supported on hangers, rolls, brackets, etc. and in manner to allow for proper expansion and elimination of vibration.
 8. 2" and smaller pipe, where run on walls, shall be supported on wrought iron "J" hook brackets with anchor bolts.
 9. All horizontal pipes, where run overhead or on walls, shall be supported as follows unless otherwise indicated: On adjustable steel clevis type hangers suspended on hanger rods, pipe sizes up to and including 4".
- F. Space limitations in hung ceilings spaces and conditions in other locations may require use of other type of hangers than those specified above. Suitable and approved pipe hangers shall be provided for such job conditions.
- G. All supports shall be fastened to structural members or additional steel supports furnished by this Contractor.
- H. Hanger rods shall be steel, threaded with nuts and lock nuts sizes in accordance with the following schedule:
- | <u>Pipe Size</u> | <u>Rod Size</u> |
|-------------------------|-----------------|
| 3/4" to 2" inclusive | 3/8" |
| 2-1/2" and 3' inclusive | 1/2" |
| 4" and 5" inclusive | 5/8" |
- I. Hangers for copper tubing shall be tacked up with formed lead sheet on which tubing or pipe shall be placed.
- J. Where pipes pass through masonry, concrete walls, foundations, or floors, this Contractor shall set sleeves as are necessary for passage of pipes. These sleeves shall be of sufficient size to permit insulation where required to be provided around pipe passing through. This Contractor shall be responsible for exact location of these sleeves.

- K. Sleeves shall not be used in any portion of building where use of same would impair strength of construction features of the building. Inserts for supporting lateral pipes and equipment shall be placed and secured to form work, and all sleeves inserts locations shall be thoroughly checked with Architect so as not to conflict with other trades.
- L. Where pipes pass through floor or walls, they shall be provided with chromium plated escutcheons.
- M. Anchor horizontal piping where indicated and wherever necessary to localize expansion or prevent undue strain on branches. Anchors: Heavy forged construction entirely separate from supports.
- N. Anchor vertical piping wherever indicated and wherever necessary to prevent undue strain on offsets and branches. Anchors, unless otherwise noted: Heavy steel clamps securely bolted and welded to pipes. Extension ends shall bear on building construction.
- O. Ducts shall be hung with 1" x 1/8" metal straps. When width of duct is less than 48", hangers shall be fastened to side of ducts. Auxiliary steel supports that may be required for all mechanical equipment shall be furnished and installed by this Contractor. All operating equipment including fans, piping, etc. shall be supported so as to produce minimum amount of noise transmission.
- P. Refer to "General Conditions" as well.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230420

SECTION 230430

INSULATION AND COVERINGS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

- A. Furnish insulation for all piping, equipment and sheet-metal work as noted.
- B. Insulate no piping, ducts or equipment until tested and approved for tightness. All piping and ducts shall be dry when covered. Where existing insulation has been damaged, altered or removed during the course of the work, it shall be replaced with new insulation in a neat manner to match the adjacent insulation.
- C. All insulation must be done by an approved Sub-Contractor or by mechanics skilled in this line of work.
- D. Fire hazard classification shall be 2550 per ASTM E-84, NFPA 255 and UL 723. Insulation shall be rated non-combustible type classified flame spread - 25, smoke developed - 50.

PART 2 - PRODUCTS

2.1 DUCTWORK (INDOOR)

- A. Supply, outside air intake and exhaust (on discharge side of fan) and return ductwork shall be covered with fiberglass insulation (unless otherwise indicated) with aluminum foil vapor barrier. All joints shall be lapped so maximum coverage is achieved.
- B. All insulated ductwork shall be insulated with fiberglass board insulation with canvas finish in areas where ductwork is exposed.
- C. Insulation thickness shall be in accordance with the latest edition of the State Energy Code.
- D. Thermal acoustic lining of ductwork where indicated, but always within the first 15 feet of the rooftop unit shall be 1" thickness closed cell non-fiberglass unless otherwise noted. The lining shall have a mat facing and shall meet the Life Safety Standards as established by NFPA 90A and 9B and conform to the requirements of ASTM C 1071.

2.2 PIPING/EQUIPMENT (INDOOR)

- A. All new heating water system supply and return piping shall be covered with Manville Micro-Lok or equal approved fiberglass insulation with all service (factory applied) vapor retardant jacket. Seal with type H mastic.

- B. Fittings shall be insulated with same material and thickness as adjoining pipe insulation and shall be pre-molded fittings or mitre cut segmental insulation wired on. Over the insulation, apply a wrapper of OCF glass cloth sealed with type H mastic. Apply aluminum bands on pipe covering in addition to self-sealing feature.
- C. Insulation Material: Molded fibrous glass insulation, density not less than 4 lbs. per cubic foot.
- D. Insulation Thickness: Shall be in accordance with the latest edition of the State Energy Code.
- E. Jacket and Finish: White flame retardant type, meeting all requirements of "Fire Hazard Classification" of NFPA, similar to "Fiberglass" Type FRJ, Insul-Coustic, Johns-Manville or approved equal.
- F. Insulation and Finishes for Fittings, Valves and Flanges
 - 1. Valves, fittings and flanges other than vapor seal insulation: Insulated in same manner and same thickness as piping in which installed.
 - 2. Use pre-molded sectional covering where available; otherwise use mitered segments of pipe covering.
 - 3. Obtain written approval prior to using other than molded sectional covering.
- G. Vapor seal Insulation for Valves, Fittings and Flanges: Same as above, except joints sealed with vapor barrier adhesive and wrapped with glass mesh tape. Each fitting shall be finished with two coats of vapor seal mastic adhesive.
- H. Jacket and Finishes: Exposed fittings - 6 oz. canvas jacket adhered with lagging adhesive.
- I. Concealed fittings: Standard weight canvas jacket adhered with lagging adhesive and with bands of 18 gauge copper coated steel - 2 bands at elbows, 3 at tee.
- J. Insulation at Pipe Hangers
 - 1. Where shields are specified at hangers on piping with fibrous glass covering, provide load bearing calcium silicate between shields and piping as follows:
 - a. For pipe covering without vapor barrier jacket, furnish at each shield 12" - long calcium silicate section with canvas section with canvas jacket continuous between shield and insulation.
 - b. For pipe covering with vapor barrier jacket, furnish at each shield 12" - long vapor barrier jacket section with section of fibrous glass replaced with section of calcium silicate. Vapor barrier jacket, continuous between shield and insulation for continuous vapor barrier.
- K. Condensate drain and refrigerant piping shall be insulated with 1/2" Imcosheild un-split polyolefin insulation.

L. Equipment

1. Secure fibrous glass block or board insulation in place with wire or galvanized steel bands.
 - a. Small Areas: Secure insulation with 16 gauge wire on maximum 6" centers.
 - b. Large Areas: Secure insulation with 14 gauge wire or .015" thick by 1/2" wide galvanized steel bands on maximum 10" centers. Stagger insulation joints.
 - c. Irregular Surfaces: Where application of block or board insulation is not practical insulate with insulating cement built-up to same thickness as adjoining insulation.
2. Fill joints, voids and irregular surfaces with insulating cement to a uniform thickness.
3. Stretch wire mesh over entire insulated surface and secure to anchors with wire edges laced together.
4. Apply finishing cement, total of 1/2" thick, in 1/4" thick coats. Trowel second coat to a smooth hard finish. Neatly bevel insulation around hand-holes, cleanouts, ASME stamp, manufacturer's nametag and catalog number.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.
- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230430

SECTION 230440

DAMPERS AND MISCELLANEOUS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

PART 2 - PRODUCTS

2.1 DAMPERS AND MISCELLANEOUS

- A. Furnish and install where shown on Drawings ARROW PIN-LOCK Dampers No. OBDPL-507 (Opposed) as manufactured by the Arrow Louver & Damper Corp. of Maspeth, NY 11378, or approved equal. Frames and blades to 1/8" extruded aluminum.
- B. Blades to be single unit PIN-LOCK design 6" wide, with the PIN-LOCK an integral section within the blade center axis. Frames to be a combination of 4" extruded aluminum channel and angle, with reinforcing bosses and groove inserts for vinyl seals.
- C. Pivot rods to be 1/2" diameter extruded aluminum, PIN-LOCK design interlocking into blade section. Bearings to be "Double-Sealed" type with Celcon inner bearing on rod riding in Merlon Polycarbonate outer bearing inserted in frame so that outer bearing cannot rotate.
- D. Blade linkage hardware is to be installed in angle or channel frame section out of air stream. All hardware to be of non-corrosive reinforced material or to be cadmium plated.
- E. Rod bearing to be designed for minimum air leakage by means of overlapping design and by extruded vinyl seals to fit into integral ribbed groove inserts in both frames and blades. All dampers in excess of 10 sq. ft. free area to have reinforced corners by means of gusset plates.
- F. Dampers shall be sized by the Control Manufacturer to properly control the flow of air and ensure minimum air stratification in mixing applications. Sizing shall be submitted for approval with information similar to that submitted on valve when sizing valve.

2.2 FIRE DAMPERS

- A. Dampers shall be multi blade construction UL labeled and be installed in accordance with UL 555, with breakaway connections. The units shall have stainless steel actuator springs with locking devices for horizontally mounted type.

2.3 COMBINATION FIRE / SMOKE DAMPERS

- A. Furnish and install at locations shown on Drawings, or as described in schedules, combination fire smoke dampers.

- B. Frame shall be a minimum of 16 gauge galvanized steel formed into a structural hat channel reinforced at corners for added strength. The blades shall be airfoil shaped single-piece hollow construction with 14 gauge equivalent thicknesses. Blade action shall be opposed. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame for long life. Galvanized bearing shall not be acceptable.
- C. Blade edge seals shall be silicone rubber and galvanized steel mechanically locked into blade edge (adhesive or clip fastened seals shall be acceptable) and shall withstand a minimum of 450 degrees F. (232 degrees C.) Jamb seals shall be non-corrosive stainless steel flexible metal compression type to further ensure smoke management.
- D. Each combination fire/smoke damper shall be classified for use for fire resistance ratings of less than 3 hours in accordance with UL Standard 555, and shall further be classified by Underwriters Laboratories as a Leakage Rated Damper for use in smoke control systems in accordance with the latest version of UL555S, and bear a UL label attesting to same. Damper manufacturer shall have tested, and qualified with UL, a complete range of damper sizes covering all dampers, required by this Specification. Testing and UL qualifying a single damper size is not acceptable. The leakage rating under UL555S shall be leakage Class I (4 c.f.m./sq. ft. at 1" w.g. and 8 c.f.m./ft. at 4" w.g.).
- E. As part of UL qualification, dampers shall have demonstrated a capacity to operate (to open and close) under HVAC system operating conditions, with pressures of at least 4" w.g. in the closed position, and 4000 f.p.m. air velocity in the open position.
- F. In addition to the leakage rating already specified herein, the dampers and their actuators shall be qualified under UL555S to an elevated temperature of 350 degrees F. (177 degrees C.). Appropriate electric actuators (equal to Ruskin model MA) shall be installed by the damper manufacturer at time of damper fabrication. Damper and actuator shall be supplied as a single entity, which meets all applicable UL555S qualifications for both dampers and actuators. Damper and actuator assembly shall be factory cycled 10 times to assure operation.
- G. Manufacturer shall provide factory assembled sleeve of 17" minimum length (Contractor to verify requirement). Factory supplied caulked sleeve shall be 20 gauge for dampers through 84" wide and 18 gauge above 84" wide.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Inspect equipment space locations before beginning installation. Verify that the space is correct for entry and access. Do not proceed with installation of the equipment until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's instructions and recommendations for installation of equipment, accessories and components.

- B. All heating, ventilating and air conditioning equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.

3.3 CLEANING

- A. Clean interior and exterior surfaces promptly after installation of equipment and components. Take care to avoid damage to protective coatings and finishes. Remove excess sealants, lubrication, dirt and other foreign substances.

END OF SECTION 230440

SECTION 230460

AUTOMATIC TEMPERATURE CONTROLS

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 QUALIFICATIONS OF BIDDER

- A. All bidders must be building automation contractors in the business of installing direct digital control building automation systems for a minimum of 10 years.
- B. All bidders must have an office in the within 50 miles of jobsite.
- C. All bidders must be authorized distributors or branch offices of the manufacturers specified.
- D. All bidders must have a trained staff of application Engineers, who have been certified by the manufacturer in the configuration, programming and service of the automation system.

1.2 SCOPE OF WORK

- A. This Contractor shall furnish an electronic system of temperature controls. The District has standardized on Alerton. The ATC Sub-Contractor shall be subject to the Owner's approval.
- B. The BAS Contractor shall review and study all HVAC Drawings and the entire Specification to familiarize himself with the equipment and system operation and to verify the quantities and types of dampers, operators, alarms, etc. to be provided.
- C. Prior to commencement of schedule programming meet with Owner to discuss block/individual scheduling of system/equipment and alarm protocols. Review equipment designations and graphics screens to be provided. Take minutes of this meeting and issue them to the Construction Manager/Owner's representative.
- D. RS-232 Drivers or Hardware Translators: All DDC components shall communicate on existing Level 1 or Level 2 networks in native mode.
- E. The new installed system shall communicate to the existing graphic Workstation in the Buildings and Grounds office. All new graphics shall match established standards of the existing District system.
- F. All temperature control wiring regardless of voltage shall be done by this Contractor. This shall include power wiring of control panels/components from available spare circuits in electrical panels. The automatic temperature control manufacturer shall provide wiring diagrams, field supervision and one (1) year guarantee on the installed DDC system and three (3) year factory warrantee on all control equipment manufactured by the DDC manufacturer.

- G. Thermostats, temperature sensors, heating control devices, etc. are indicated on the Drawings in general. Provide any additional devices required to carry out project intent as herein described.
 - H. Thermostats/Temperature sensors in areas subject to vandalism shall have in addition separately mounted extra heavy guards. Submit sample.
 - I. Contractor shall include all new heating control devices, thermostats, etc. indicated on Drawings or that is part of a new system.
 - J. Contractor shall furnish all necessary electrical controls, motor starters, switches, etc. for proper operation of equipment furnished by him under this Contract, and as herein noted.
 - K. Point and component lists are to be used as a guide. If the sequence of operation requires additional points/control devices, this Contractor shall be responsible for providing same.
 - L. All control system components installed shall be manufactured by the DDC system manufacturer.
 - M. Communications cabling shall be run in hallways above hung ceiling with plenum cable and wiremold where exposed.
 - N. Removals shall include switches, relays, electric components not required for the new intent. Do not leave behind items with no function. Provide appropriate blanking plates/patching where removals occur in finished spaces.
 - O. Provide services and manpower necessary for commissioning of system in coordination with the HVAC Contractor, Balancing Contractor and Owner's representative.
- 1.2 SOFTWARE CODE
- A. Owner shall be furnished with a complete, hard-bound copy of all installed software code. Final payment shall be contingent upon this requirement being met.
- 1.3 CODE COMPLIANCE
- A. Provide components and ancillary equipment, which are UL-916 listed and labeled.
 - B. All equipment or piping used in conditioned air streams, spaces or return air plenums shall comply with NFPA 90A Flame/Smoke/Fuel contribution rating of 25/50/0 and all applicable building codes or requirements.
 - C. All wiring shall conform to the National Electrical Code.
 - D. Comply with FCC rules, Part 15 regarding Class A radiation for computing devices and low power communication equipment operating in commercial environments.
 - E. Comply with FCC, Part 68 rules for telephone modems and data sets.

1.4 SUBMITTALS

- A. All shop drawings shall be prepared in Visio Professional or AutoCAD software. In addition to the Drawings, the Contractor shall furnish a CD containing the identical information. Drawings shall be B size or larger.
- B. Shop drawings shall include a riser diagram depicting locations of all controllers and workstations, with associated network wiring. Also included shall be individual schematics of each mechanical system showing all connected points with reference to their associated controller. Typical will be allowed where appropriate.
- C. Submittal data shall contain manufacturer's data on all hardware and software products required by the Specification. Valve damper and airflow station schedules shall indicate size, configuration, capacity and location of all equipment.
- D. Software submittals shall contain narrative descriptions of sequences of operation, program listings, point lists, and a complete description of the graphics, reports, alarms and configuration to be furnished with the workstation software. Information shall be bound or in a three ring binder with an index and tabs.
- E. Submit submittal data and shop drawings to the Engineer for review prior to ordering or fabrication of the equipment. The Contractor prior to submitting shall check all Documents for accuracy.
- F. The Engineer will make corrections, if required, and return to the Contractor. The Contractor will then resubmit with the corrected or additional data. This procedure shall be repeated until all corrections are made to the satisfaction of the Engineer and the submittals are fully approved.

1.5 SYSTEM STARTUP AND COMMISSIONING

- A. Each point in the system shall be tested for both hardware and software functionality. In addition, each mechanical and electrical system under control of the BAS will be tested against the appropriate sequence of operation specified herein. Successful completion of the system test shall constitute the beginning of the warranty period. A written report will be submitted to the Owner indicating that the installed system functions in accordance with the Drawings and Specifications.
- B. The ATC Contractor shall commission and set in operating condition all major equipment and systems, such as steam heating, DX cooling, heat recovery and all air handling systems, in the presence of the equipment manufacturer's representatives, as applicable, and the Owner and Architect's representatives.
- C. The ATC Contractor shall provide all manpower and engineering services required to assist the HVAC Contractor and Balancing Contractor in testing, adjusting, and balancing all systems in the building Scope of Work. The Contractor shall have a trained technician available on request during the balancing of the systems. The Contractor shall coordinate all requirements to provide a complete air balance with the Balancing Contractor and shall include all labor and materials in his Contract.

1.6 OPERATING AND MAINTENANCE MANUALS

- A. The operation and maintenance manuals shall contain all information necessary for the operation, maintenance, replacement, installation and parts procurement for the entire system. This documentation shall include specific part numbers and software versions and dates. A complete list of recommended spare parts shall be included with the lead-time and expected frequency of use of each part clearly identified.
- B. Following project completion and testing, the Contractor will submit As-Built Drawings reflecting the exact installation of the system. The as-built documentation shall also include a copy of all application software both in written form and on CD.

1.7 WARRANTY

- A. The Contractor shall provide system warranty for 12 months after system acceptance or beneficial use by the Owner. During the warranty period, the Contractor shall be responsible for all necessary revisions to the software as required to provide a complete and workable system consistent with the letter and intent of the Sequence of Operation section of the Specification.
- B. Updates to the manufacturer's software shall be provided at no charge during the warranty period.

PART 2 - PRODUCTS

2.1 CONTROL VALVES (With Electric Actuator)

- A. Provide automatic control valves suitable for the specified controlled media (water or glycol). Provide valves, which mate and match the material of the connected piping. Equip control valves with the actuators of required input power type and control signal type to accurately position the flow control element and provide sufficient force to achieve required leakage specification.
- B. Control valves shall meet the heating and cooling loads specified, and closes off against the differential pressure conditions within the application. Valves should be sized to operate accurately and with stability from 10% to 100% of the maximum design flow.
- C. Trim material shall be stainless steel for hot water and high differential pressure applications.
- D. Electric actuation should be provided on all terminal unit reheat applications.

2.2 DAMPERS (With Electric Actuators)

- A. Automatic dampers, furnished by the Building Automation Contractor shall be single or multiple blades as required. Dampers are to be installed by the HVAC Contractor under the supervision of the BAS Contractor. All blank-off plates and conversions necessary to install smaller than duct size dampers are the responsibility of the Sheet-metal Contractor.

- B. Damper frames are to be constructed of 13 gauge galvanized sheet steel mechanically joined with linkage concealed in the side channel to eliminate noise as friction. Compressible spring stainless steel side seals and acetyl or bronze bearings shall also be provided.
- C. Damper blade width shall not exceed eight inches. Seals and 3/8 inch square steel zinc plated pins are required. Blade rotation is to be parallel or opposed as shown on the schedules.
- D. For high performance applications, control dampers will meet or exceed the UL Class I leakage rating.

2.3 DAMPER ACTUATORS

- A. Electronic Actuators: The actuator shall be direct coupled over the shaft, enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The actuator shall have electronic overload circuitry to prevent damage. For power-failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing. Non-spring return actuators shall have an external manual gear release to allow positioning of the damper when the actuator is not powered.
- B. All valves shall be fully proportioning, unless otherwise specified, quiet in operation, and shall be arranged to fail safe, in either a normally open or normally closed position, in the event of power failure. The open or closed position shall be as specified or as required to suit job conditions. All valves shall be capable of operating at varying rates of speed to correspond to the exact dictates of the controller and variable load requirements.
- C. Where valves operate in sequence with other valves or damper operators, provide on each valve a pilot positioner to provide adjustable operating ranges and starting points and positive close off at the required control signal pressure. Positioners must be directly connected to the valve stem. Ratio relays are not acceptable.
- D. Valves shall be sized by the Temperature Control Manufacturer and guaranteed to meet the heating or requirements as specified and indicated on the Drawings. Unless otherwise specified, all shall conform to the requirements herein specified for the piping system in which they are installed.

2.4 CENTRAL CONTROL PANEL

- A. Integrate new controls into existing central control panel. This central panel will allow for time clock scheduling, setpoints, monitoring of points and alarm. All freezestats will be reset manually at the central panel. All alarms will be displayed and reset manually at central panel.
- B. All exhaust fans shall be controlled by the central control panel.
- C. Central control panel shall be connected to existing District IT Network. District shall provide data drop.

2.5 LOCAL STAND-ALONE CONTROLLERS

- A. Provide local stand-alone controllers as required. These controllers will, through DDC programs control local units. They shall be networked together to central touch screen panel.
- B. CO2 controller shall use proportional and Integral control. Controller and sensor shall be self calibrating.

2.6 ENCLOSURES

- A. All control components shall be mounted in NEMA-1, lockable, hinged enclosures.

2.7 AUXILIARY EQUIPMENT/DEVICES

A. Analog Sensors

- 1. Duct sensors (greater than four square feet) - Monitoring range to suit application. Platinum or nickel wound RTD Type + 0.1% of range. Factory calibration point – 70 Deg. F at 1000 OHMS.
- 2. Space Temperature Sensors- Space Temperature Sensors shall be 5,000 or 10,000 ohm thermistor with wall plate adapter and blank cover assembly. The sensor shall include an integral occupancy override button and shall also include a RJ11 communications port. Space Temperature Sensors shall include space temperature adjustment slides where shown on the plans. The Space Temperature Sensors shall be mounted approximately 60" above the floor.
- 3. Hydronic Well Temperature Sensors-Water Temperature Sensors shall be well mounted 5,000 or 10,000 ohm thermistors.
- 4. Status Indication- Status indication for fans and pumps shall be provided by a current sensing sensor. The sensor shall be installed at the motor starter or motor to provide load indication. The unit shall consist of a current transformer, a solid state current sensing circuit (with adjustable set point) and a solid state switch. A red light emitting diode (LED) shall indicate the on off status of the unit. The switch shall provide a N.O. contact for wiring back to the Field Installed Controller.
- 5. Combination CO2 and Space Temperature Sensors: CO2 and space sensors are comprised of two sensors housed in one unit designed to measure both CO2 in the air and the building air temperature. Combination sensor shall have the following features:
 - a. Self Calibration CO₂ sensor with 5 year calibration interval.
 - b. Push button over ride.
 - c. CO₂ sensitivity +/- 20 ppm.
 - d. CO₂ accuracy +/- 100 ppm.
 - e. Space sensor: 5 or 10K thermistor.

2.8 DDC SENSORS AND POINT HARDWARE

A. Temperature Sensors

1. All temperature devices shall use precision thermistors accurate to ± 1 degree F over a range of -30 to 230 degrees F. Space temperature sensors shall be accurate to $\pm .5$ degrees F over a range of 40 to 100 degrees F.
2. Standard space sensors shall be available in an off white enclosure for mounting on a standard electrical box.
3. Where manual overrides are required, the sensor housing shall feature both an optional sliding mechanism for adjusting the space temperature setpoint, as well as a push button for selecting after hours operation.
4. Where a local display is specified, the sensor shall incorporate either an LED or LCD display for viewing the space temperature, setpoint and other operator selectable parameters. Using built in buttons; operators shall be able to adjust setpoints directly from the sensor.
5. Duct temperature sensors shall incorporate a thermistor bead embedded at the tip of a stainless steel tube. Probe style duct sensors are useable in air handling applications where the coil or duct area is less than 14 square feet.
6. Averaging sensors shall be employed in ducts, which are larger than 14 square feet. The averaging sensor tube must contain at least one thermistor for every 3 feet, with a minimum tube length of 12 feet.
7. Immersion sensors shall be employed for measurement of temperature in all chilled and hot water applications as well as refrigerant applications. Thermal wells shall be brass or stainless steel for non-corrosive fluids below 250 degrees F. and 300 series stainless steel for all other applications.
8. A pneumatic signal shall not be allowed for sensing temperature.

B. Humidity Sensors

1. Humidity devices shall be accurate to $\pm 5\%$ at full scale for space and $\pm 3\%$ for duct and outside air applications. Suppliers shall be able to demonstrate that accuracy is NIST traceable.
2. Provide a hand held field calibration tool that both reads the output of the sensor and contains a reference sensor for ongoing calibration.

C. Pressure Sensors

1. Air pressure measurements in the range of 0 to $10''$ water column will be accurate to $\pm 1\%$ using a solid-state sensing element. Acceptable manufacturers include Modus Instruments and Mamac.
2. Differential pressure measurements of liquids or gases shall be accurate to $\pm 0.5\%$ of range. The housing shall be NEMA 4 rated.

D. Current and KW Sensors

1. Current status switches shall be used to monitor fans, pumps, motors and electrical loads. Current switches shall be available in solid and split core models, and offer either a digital or an analog signal to the automation system. Acceptable manufacturer is Veris or approved equal.
2. Measurement of three-phase power shall be accomplished with a kW/kWH transducer. This device shall utilize direct current transformer inputs to calculate the instantaneous value (kW) and a pulsed output proportional to the energy usage (kWH). Provide Veris Model 6000 Power Transducer or approved equal.

E. Flow Sensors

1. Provide an insertion vortex flow meter for measurement of liquid or gas flows in pipe sizes above 3 inches.
2. Install the flow meter on an isolation valve to permit removal without process shutdown.
3. Sensors shall be manufactured by EMCO or approved equal.

F. Carbon Dioxide Sensors

1. Non-Dispersive Infrared (NDIR), 0-2000 PPM.
2. Power Requirement, 18-30 VDC.
3. Voltage output, 0-10- VDC Full Scale.
4. Current output, 4-20 mA

2.9 AIRFLOW MEASURING STATIONS

- A. Provide a thermal anemometer using instrument grade self heated thermistor sensors with thermistor temperature sensors. The flow station shall operate over a range of 0 to 5,000 feet/min with an accuracy of +/- 2% over 500 feet/min and +/- 10 ft/min for reading less than 500 feet/min.
- B. The output signal shall be linear with field selectable ranges including 0-5 VDC, 0-10VDC and 4-20 mA.
- C. Furnish Ebtron Series 3000 airflow stations or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. All DDC Controllers shall be networked to Central Communications controller.
- B. Existing Front End Workstation in B & G office shall be configured for access to all HVAC equipment included in this project. Text/Graphic screens for each system shall match existing.
- C. Communications cabling shall be run in hallways above hung ceiling with plenum cable and wiremold where exposed.

3.2 CONTRACTOR RESPONSIBILITIES

- A. General: The Contractor or a Sub-Contractor shall perform installation of the building automation system. However, all installation shall be under the personal supervision of the Contractor. The Contractor shall certify all work as proper and complete.
- B. Demolition: Remove controls, which do not remain as part of the building automation system, all associated abandoned wiring and conduit and all associated pneumatic tubing. The Owner will inform the Contractor of any equipment, which is to be removed, that will remain the property of the Owner. The Contractor will dispose of all other equipment that is removed.
- C. Access to Site: Unless notified otherwise, entrance to building is restricted. No one will be permitted to enter the building unless their names have been cleared with the Owner or the Owner's representative.
- D. Code Compliance: All wiring shall be installed in accordance with all applicable electrical codes and will comply with equipment manufacturer's recommendations. Should any discrepancy be found between wiring Specifications in Division 17 and Division 16, wiring requirements of Division 17 will prevail for work specified in Division 17.
- E. Cleanup: At the completion of the work, all equipment pertinent to this Contract shall be checked and thoroughly cleaned, and all other areas shall be cleaned around equipment provided under this Contract. Clean the exposed surfaces of tubing, hangers, and other exposed metal of grease, plaster, or other foreign materials.

3.3 WIRING, CONDUIT, TUBING AND CABLE

- A. All wire will be copper and meet the minimum wire size and insulation class listed below:

Wire Class	Wire Size	Isolation Class
Power	12 Gauge	600 Volt
Class One	14 Gauge Std.	600 Volt
Class Two	18 Gauge Std.	300 Volt
Class Three	18 Gauge Std.	300 volt
Communications	Per Mfr.	Per Mfr.

- B. Power and Class One wiring may be run in the same conduit. Class Two and Three wiring and communications wiring may be run in the same conduit.
- C. Where different wiring classes terminate within the same enclosure, maintain clearances and install barriers per the National Electric Code.
- D. Where wiring is required to be installed in conduit, EMT shall be used. Conduit shall be minimum 1/2 inch galvanized EMT. Setscrew fittings are acceptable for dry interior locations. Watertight compression fittings shall be used for exterior locations and interior locations subject to moisture. Provide conduit seal off fitting where exterior conduits enter the building or between areas of high temperature/moisture differential.

- E. Flexible metallic conduit (max. 3 feet) shall be used for connections to motors, actuators, controllers, and sensors mounted on vibration producing equipment. Liquid-tight flexible conduit shall be use in exterior locations and interior locations subject to moisture.
- F. Junction boxes shall be provided at all cable splices, equipment termination, and transitions from EMT to flexible conduit. Interior dry location J-boxes shall be galvanized pressed steel, nominal four-inch square with blank cover. Exterior and damp location JH-boxes shall be cast alloy FS boxes with threaded hubs and gasket covers.
- G. Where the space above the ceiling is a supply or return air plenum, the wiring shall be plenum rated. Teflon wiring can be run without conduit above suspended ceilings. EXCEPTION: Any wire run in suspended ceilings that is used to control outside air dampers or to connect the system to the fire management system shall be in conduit.
- H. Coaxial cable shall conform to RG62 or RG59 rating. Provide plenum rated coaxial cable when running in return air plenums.

3.4 HARDWARE INSTALLATION

A. Installation Practices for Wiring and Tubing

1. All controllers are to be mounted vertically and per the manufacturer's installation documentation.
2. The 120 VAC power wiring to each Ethernet or Remote Site controller shall be a dedicated run, with a separate breaker. Each run will include a separate hot, neutral and ground wire. The ground wire will terminate at the breaker panel ground. This circuit will not feed any other circuit or device.
3. A true earth ground must be available in the building. Do not use a corroded or galvanized pipe, or structural steel.
4. Wires are to be attached to the building proper at regular intervals such that wiring does not drop. Wires are not to be affixed to or supported by pipes, conduit, etc.
5. Wiring in finished areas will be concealed in ceiling cavity spaces, plenums, and furred spaces and wall construction. Exception; metallic surface raceway may be used in finished areas on masonry walls. All surface raceway in finished areas must be color matched to the existing finish within the limitations of standard manufactured colors.
6. Wiring, in non-finished areas where possible, will be concealed in ceiling cavity spaces, plenums, furred spaces, and wall construction. Exposed conduit will run parallel to or at right angles to the building structure.
7. Wires are to be kept a minimum of three (3) inches from hot water or condense piping.
8. Where sensor wires leave the conduit system, they are to be protected by a plastic insert.

B. Installation Practices for Field Devices

1. Well-mounted sensors will include thermal conducting compound within the well to insure good heat transfer to the sensor.
2. Actuators will be firmly mounted to give positive movement and linkage will be adjusted to give smooth continuous movement throughout 100 percent of the stroke.
3. Relay outputs will include transient suppression across all coils. Suppression devices shall limit transients to 150% of the rated coil voltage.
4. Water line mounted sensors shall be removable without shutting down the system in which they are installed.
5. For duct static pressure sensors, the high-pressure port shall be connected to a metal static pressure probe inserted into the duct pointing upstream. The low-pressure port shall be left open to the plenum area at the point that the high-pressure port is tapped into the ductwork.
6. For building static pressure sensors, the high-pressure port shall be inserted into the space via a metal tube. Pipe the low-pressure port to the outside of the building.

D. Enclosures

1. For all I/O requiring field interface devices, these devices, where practical, will be mounted in a field interface panel (FIP). The Contractor shall provide an enclosure, which protects the device(s) from dust, moisture, conceals integral wiring and moving parts.
2. FIP's shall contain power supplies for sensors, interface relays and Contractors, safety circuits, and I/P transducers.
3. The FIP enclosure shall be of steel construction with baked enamel finish; NEMA 1 rated with a hinged door and keyed lock. The enclosure will be sized for 20% spare mounting space. All locks will be keyed identically.
4. All wiring to and from the FIP will be to screw type terminals. Analog or communications wiring may use the FIP as a raceway without terminating. The use of wire nuts within the FIP is prohibited.
5. All outside mounted enclosures shall meet the NEMA-4 rating.
6. The wiring within all enclosures shall be run in plastic track. Wiring within controllers shall be wrapped and secured.

E. Identification

1. Identify all control wires with labeling tape or sleeves using words, letters, or numbers that can be exactly cross-referenced with As-Built Drawings.
2. All field enclosures, other than controllers, shall be identified with a Bakelite nameplate. The lettering shall be in white against a black or blue background.
3. Junction box covers will be marked to indicate that they are a part of the BAS system.
4. All I/O field devices (except space sensors) that are not mounted within FIP's shall be identified with nameplates.
5. All I/O field devices inside FIP's shall be labeled.

F. Control System Switch-Over

1. Demolition of the existing control system will occur after the new temperature control system is in place including new sensors and new field interface devices.
2. Switch over from the existing control system to the new system will be fully coordinated with the Owner. A representative of the Owner will be on site during switch over.
3. The Contractor shall minimize control system downtime during switch over. Sufficient installation mechanics will be on site so that the entire switch over can be accomplished in a reasonable time frame.

G. Location

1. The location of sensors is per Mechanical and Architectural Drawings.
2. Outdoor air sensors will be mounted on the north building face directly in the outside air. Install these sensors such that the effects of heat radiated from the building or sunlight is minimized.
3. Field enclosures shall be located immediately adjacent to the controller panel(s) to which it is being interfaced.

3.5 SOFTWARE INSTALLATION

- A. General: The Contractor shall provide all labor necessary to install, initialize, start-up and debug all system software as described in this section. This includes any operating system software or other third party software necessary for successful operation of the system.
- B. Database Configuration: The Contractor will provide all labor to configure those portions of the database that are required by the points list and sequence of operation.

- C. Color Graphic Slides: Unless otherwise directed by the Owner, the Contractor will provide color graphic displays as depicted in the Mechanical Drawings for each system and floor plan. For each system or floor plan, the display shall contain the associated points identified in the point list and allow for set point changes as required by the Owner.
- D. Reports - The Contractor will configure a minimum of 6 reports for the Owner as listed below:
 - 1. Central Plant Status Report
 - 2. Air Handler Status Report
 - 3. Energy Consumption Report
 - 4. Space Temperature Report
 - 5. Specialty Equipment Status Report
- E. Documentation - As-Built software documentation will include the following:
 - 2. Descriptive point lists
 - 3. Application program listing
 - 4. Application programs with comments
 - 5. Printouts of all reports
 - 6. Alarm list
 - 7. Printouts of all graphics

3.6 COMMISSIONING AND SYSTEM STARTUP

- A. Point-to-Point Checkout: Each I/O device (both field mounted as well as those located in FIP's) shall be inspected and verified for proper installation and functionality. A checkout sheet itemizing each device shall be filled out, dated and approved by the Project Manager for submission to the Owner or Owner's representative.
- B. Controller and Workstation Checkout: A field checkout of all controllers and miscellaneous equipment shall be conducted to verify proper operation of both hardware and software. A checkout sheet itemizing each device and a description of the associated tests shall be prepared and submitted to the Owner or Owner's representative by the completion of the project.
- C. System Acceptance Testing
 - 1. All application software will be verified and compared against the sequences of operation. Control loops will be exercised by inducing a setpoint shift of at least 10% and observing whether the system successfully returns the process variable to setpoint. Record all test results and attach to the Test Results Sheet.
 - 2. Test each alarm in the system and validate that the system generates the appropriate alarm message, that the message appears at all prescribed destinations (workstations or printers), and that any other related actions occur as defined (i.e. graphic panels are invoked, reports are generated, etc.). Submit a Test Results Sheet to the Owner.

3. Perform an operational test of each unique graphic display and report to verify that the item exists, that the appearance and content are correct, and that any special features work as intended. Submit a Test Results Sheet to the Owner.
 4. Perform an operational test of each third party interface that has been included as part of the automation system. Verify that all points are properly polled, that alarms have been configured, and that any associated graphics and reports have been completed. If the interface involves a file transfer over Ethernet, test any logic that controls the transmission of the file, and verify the content of the specified information.
- D. Provide extended commissioning (1 year) to check calibration of CO2 sensors and monitor/test CO2 levels to ensure target per-person ventilation rates are met and maintained.
- E. Control system shall record space and outdoor air CO2 concentrations during occupancy at not greater than 15-minute intervals. Records of CO2 concentrations shall be kept for a minimum of three years.

3.7 SEQUENCES OF OPERATION

A. Packaged Rooftop Ventilation/Energy Recovery Unit (ERU-1)

1. Point List

- b. Supply Fan VFD (Speed and Status)
- c. Exhaust Fan VFD (Speed and Status)
- d. Energy Recovery Core Bypass Damper Status)
- e. Space Temperature
- f. Space Temperature Setpoint(s)
- g. OA, EA Temperatures
- h. Heating Stages (heat pump)
- i. OA, EA Damper
- j. Freeze-stat
- k. Discharge Air Temperature
- l. DX Cooling Start/Stop/Status
- m. Hot Water Coil Mixing Valve Modulation (duct mounted)

2. Sequence of Operation

- a. Unoccupied: In this mode:
Supply and Exhaust fans off, OA and EA dampers closed. If the respective unoccupied space temperature is not maintained by the cab heaters or VRF units, the rooftop ventilation unit shall cycle on. If additional heat is required, the unit heat pump shall be energized. The heating coil valve as stage 4 shall modulate to satisfy the space heating setpoint. Upon satisfaction, the rooftop unit shall stop until the next cycle, if required.
- b. Warm-up: During the heating season, a warm-up mode will be invoked if the return air temperature is below 60°F (adj.) upon unit start-up. In this mode:

- The OA dampers will open and thru a hard wired interlock and the supply fan will start. Fan will slowly ramp up to preset speed. The warm-up program will reset the heating supply air temperature set point to 80°F (adj.). The heating (heat pump and hot water coil) will modulate to maintain the supply air temperature setpoint. The supply air setpoint will be reset linearly and inversely from 80°F (adj.) to 70°F (adj.) as the return air temperature increases from 60°F to 70°F (adj.)
- Once the return air has reached 72°F (adj.) the HVAC shall be controlled as described in the occupied mode.

c. Occupied: The OA and EA dampers will open

- Supply fan will start and ramp up slowly to its' preset speed via VFD. The return fan will follow and track the supply fan as needed.
- Unit shall operate in heat pump mode to maintain a discharge air temperature of 72 degrees for ventilation. If additional heat is needed, the hot water coil control valve shall modulate to maintain the 72 degree setpoint. The VRF Ductless cassettes shall operate in heat pump mode to maintain the space heating setpoint. If additional heat is needed, the hot water coil control valve shall modulate to increase the ventilation air temperature from normal 72 degrees, up to 90 degrees, if required. The supply air setpoint will be reset linearly and inversely from 90°F (adj.) to 72°F (adj.) as the return air temperature increases (adj.).
- Direct expansion cooling system shall operate as needed to maintain occupied cooling setpoint (adjustable).
- An adjustable dead band offset will prevent short cycling.
- Note: the energy recovery core shall have freeze protection integral to the unit.
- Minimum outdoor air shall be as scheduled on drawings.

d. Economizer Mode: In this mode:

- If the outside air temperature is greater than the return air temperature, the system will operate as described in the occupied mode.
- If the outside temperature is less than the return air temperature and the outside air temperature is greater than 50°F (adjustable), the core bypass dampers shall open and the core face air damper shall close. This will be the first stage of Cooling.
- Should additional cooling be required, the mechanical D/X cooling will modulate as needed.

e. Alarms: In this mode:

- The freezestat mounted after the hot water coil will protect the coil from freezing. Should the freezestat go into alarm the supply and return fans will shut off. The OA and EA dampers will be closed.

The OA and EA bypass dampers will be closed. The RA damper shall be open. The hot water coil valve will be open. An alarm will be generated at the operators work station. Note: The freezestat will be able to be reset from the operator's work station.

- Should the command not equal the status within 90 seconds from start-up an alarm will be generated at the operator's work station.
- Should any temperature fall outside of its preset limits (high/low) an alarm will be generated at the operator's work station.

B. Cabinet Heaters

1. Point List

- a. Space Temperature
- b. Space Temperature Setpoint
- c. Fan Start/Stop

2. Sequence of Operation: Unit fan shall start/stop to maintain space temperature setpoint (adjustable). Fan shall not run if return water temperature is less than 130 degrees.

C. Exhaust Fan

1. Point List

- a. Fan star/Stop
- b. Fan Status
- c. VFD Status (if applicable)

2. Sequence of Operation

- a. Unoccupied Mode: Fan Off, Damper Closed.
- b. Occupied Mode: Fan Enabled, Damper Open. Fan speed shall ramp up to specified airflow rate.

D. VRF Ductless Split, Ceiling Cassette Units

1. Point List

- a. Space Temperature
- b. Occupied/Unoccupied
- b. VRF Space Temperature Setpoint
- d. VRF Indoor Mode (Heating/Cooling)
- e. VRF Indoor Unit fan speed
- e. Energy Recovery Unit Status
- f. Cabinet Heater Status (if applicable)
- g. VRF Outdoor Mode/status

(Provide all required hardware and software to interface the BMS with the VRF system.)

2. Sequence of Operation

- a. Unoccupied Mode: Cooling shall not operate. Cabinet heater (if applicable) shall operate as Stage 1 heating. VRF heat pump and heat recovery heating shall operate as required to satisfy space temperature setback setpoint. Rooftop unit heat pump shall operate as stage 3 heating. Hydronic hot water coil shall be stage 4 heating
- b. Occupied Mode: Cooling shall operate as required based upon its own packaged controls to maintain thermostat setpoint. Cabinet heater (if applicable) shall operate as Stage 1 heating. VRF heat pump operation shall operate as Stage 2 to maintain occupied space thermostat setpoint. Heat recovery mode shall operate as required, providing heating or cooling as required. Rooftop unit heat pump shall operate as stage 3 heating. Hydronic hot water coil shall be stage 4 heating

E. Three-Way Mixing Valve (Duct Coil)

1. Point List

- a. HWS Temperature.
- b. HWR Temperature.
- c. HW Mixed Temperature.
- d. Valve Modulation.

2. Sequence of Operation:

The three-way control valve will modulate through the DDC system to modulate the hot water supply to satisfy low limit (55 degrees adjustable) and normal discharge air (72 degrees adjustable) temperature setpoint.

F. Space Temperature Setpoints

1. Heating mode

- a. Occupied temperature setpoint shall be maximum 72 degrees F.
- b. Unoccupied temperature setpoint shall be minimum 55 degrees F.

2. Cooling mode

- a. Occupied temperature setpoint shall be minimum 74 degrees F.
- b. Unoccupied temperature setpoint shall be maximum 85 degrees F.

G. Existing Packaged Gas-Fired Rooftop Units

- 1. Units shall continue to operate according to their existing control sequence of operation.

3.8 CONTROL DIAGRAMS

- A. Complete new control diagrams showing type of apparatus, cycles of operation and details of all equipment must be submitted for checking and be approved before installation is started.
- B. Submit three (3) preliminary copies of the control diagrams, sequence descriptions, and equipment shop drawings for checking and submit six (6) copies, complete for final approval.
- C. At the completion of installation, control manufacturer shall furnish non-fading original; plastic laminated copies of all control diagrams as they apply to the particular instruments thereon. One complete set of non-fading plastic laminated diagrams shall be mounted on wall as directed.

3.9 CERTIFICATION

- A. After completion of installation and after equipment has been placed on operation, the temperature control manufacturer shall submit in writing, a complete and detailed report and certification that the entire installation is operating exactly as specified and shall be guaranteed for one year. Report shall state temperature and throttling range readings and settings of all control instruments. Submit to the Engineer preliminary for checking and approval.

3.10 INSTALLATION

- A. All work under the automatic temperature control Sub-Contract shall be done by competent skilled mechanics regularly in the employ of the temperature control manufacturer.
- B. Bidder must be a control manufacturer currently involved in the production of commercial pneumatic/electric temperature controls. Franchises and associations are not considered control manufacturers.

3.11 TRAINING

- A. The Contractor shall supply personnel to train key customer personnel in the operation and maintenance of the installed system. The training program shall be designed to provide a comprehensive understanding and basic level of competence with the system. It shall be sufficiently detailed to allow customer personnel to operate the system independent of any outside assistance. On-line context sensitive HELP screens shall be incorporated into the system to further facilitate training and operation.
- B. The training plan shall include detailed session outlines and related reference materials. The customer personnel shall be able to utilize these materials in the subsequent training of their co-workers.
 - 1. Training time shall not be less than a total of 40 hours, and shall consist of:
 - a. 16 hours during normal day shift periods for system operators. Specific schedules shall be established at the convenience of the customer.

- b. 24 hours of system training shall be provided to customer supervisory personnel so that they are familiar with system operation.
 - c. The specified training schedule shall be coordinated with the customer and will follow the training outline submitted by the Contractor as part of the submittal process.
 - d. Provide an as built Video training tape, showing and explaining all animated graphics in detail, all controllers and equipment the FMS operates (Four (4) Copies shall be supplied).
 - e. If further training is needed, the Contractor shall provide another 40 hours at no extra cost.
2. All training sessions shall be scheduled by the Construction Manager. The Contractor shall provide sign-in sheets and distribute minutes of each session prior to the subsequent session. This documentation shall be included in the Operation and Maintenance manuals.

END OF SECTION 230460

SECTION 230470

TESTING, START-UP AND ADJUSTMENTS

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

1.1 TESTING, START-UP AND ADJUSTMENTS

- A. Furnish all materials, supplies, labor and power required for testing. Make preliminary tests and prove work satisfactory. Notify Architect and all authorities having jurisdiction in ample time to be present for final testing of all piping. Test before insulating or concealing any piping. Repair defects disclosed by tests, or if required by Architect, replace defective work with new work without additional cost to Owner. Make tests in stages if so ordered by Architect to facilitate work of others. Use of wicking in tightening leaking joints not permitted.
- B. HVAC Contractor is responsible for work or other trades disturbed or damaged by tests and/or repair and replacement of his work, and shall cause work so disturbed or damaged to be restored to its original condition at his own expense.
- C. Unless otherwise specified, all piping systems shall be hydrostatically tested to 150 psig. Tests shall be of four (4) hour duration during which time piping shall show no leaks and during time no sealing of leaks will be permitted.
- D. HVAC Contractor shall balance out system and submit test reports showing operating data to include the following:
 - 1. C.F.M. of all air handling equipment.
 - 2. C.F.M. at each air outlet.
 - 3. G.P.M. for equipment.
 - 4. R.P.M. for each fan and fan motor.
 - 5. Motor power consumption.
 - 6. Air temperature readings before and after coils.
 - 7. Water temperature readings in and out of coils and through equipment.
 - 8. Pressure gauge readings before and out of all pertinent equipment.

- E. HVAC Contractor shall furnish services of qualified personnel, thoroughly familiar with job, to operate and make all adjustments so that system and control equipment shall operate as intended. This shall include adjustment/replacement of sheaves/impellers to achieve design performance. Adjustments shall be made including balancing of water and air systems in cooperation with qualified representatives of mechanical equipment manufacturers and temperature control manufacturer. This shall include any required adjustment/replacement of sheaves, belts, impellers, etc. to achieve design performance. Architect/Engineer is to be notified when this balancing is to be performed.
- F. When all work is in an acceptable operating condition, furnish operating and maintenance manuals as specified in General Requirements.
- G. All HVAC equipment shall be carefully designed, constructed and installed so as to prevent any objectionable noise or vibration reaching any part of the building outside of the mechanical equipment room. Care shall also be taken to prevent transmission of noise or odor through ductwork into other spaces.
- H. Contractor shall include in his Bid, adjustment of air quantity below scheduled C.F.M. for air systems deemed "noisy" by Owner subsequent to initial balancing.
- I. The Contractor shall be required to rectify or replace at his own expense, any equipment not complying with the foregoing requirements.
- J. Final inspection and approval shall be made only after proper completion of all of above requirements.
- K. If the performance of the systems does not conform to the design parameters the Contractor shall return to the site until the systems perform as designed.

END OF SECTION 230470

SECTION 230480

GENERAL LABELING, VALVE CHARTS AND PIPING IDENTIFICATION

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 GENERAL LABELING AND VALVE CHARTS

- A. This Contractor shall have appropriate descriptive labels, identification tags and nameplates of equipment, valves, etc. furnished and installed under this Contract and shall be properly placed and permanently secured to (or adjacent to) the item being installed. All such labels, identifications, tags, nameplates, etc. shall be selected by the Architect/Engineer.
- B. In general, labels shall be the lamacoid type of sufficient size to permit easy identification, black coated, white edged, with letters 3/16" high. Major equipment, apparatus, control panels, etc. shall have 8" x 4" lamacoid plates with lettering of appropriate size.
- C. Provide tags for all valves, automatic and manual dampers. Tags shall be Type #2020 anodized aluminum of #1420 lamacoid engraved. Tags may not necessarily be standard. Fasten tags to valve or damper with brass chain.
- D. All nameplates, labels, identifications and tags shall be as manufactured by the Seton Name Plate Co., of New Haven, CT or approved equal. Submit complete schedules, listings and descriptive data together with samples for checking and approval before purchasing. Labeling shall include the "number" of the equipment, valve, dampers, switch, etc. and service of the valve.
- E. Mount on laminated plastic boards with transparent surface all valves, wiring diagrams, control diagrams, instruction charts, permits, etc. Valve chart shall be non-fading with original copies laminated.

1.2 IDENTIFICATION OF PIPING

- A. This Contractor shall provide on all piping, semi-rigid, wrap around plastic identification markers equal to Seton Snap-Around and/or Seton Strap-On pipe markers.
- B. Each marker background is to be appropriately color coded with a clearly printed legend to identify the contents of the pipe. Directions of flow arrows are to be included on each marker.
- C. Identification of all piping shall be adjacent to each valve, at each pipe passage through wall, floor and ceiling construction and at each branch and riser take-off.
- D. Identification shall be on all horizontal pipe runs, marked every 15 ft. as well as at each inlet outlet of equipment.

END OF SECTION 230480

SECTION 230485

HVAC SYSTEMS COMMISSIONING

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 RELATED DOCUMENTS

- A. In the case of a conflict between this and any other section in the project specifications, the more stringent or detailed requirements shall apply.

1.2 DEFINITIONS

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxA: Commissioning Authority.

1.3 DESCRIPTION

- A. The systems that shall be commissioned in this project include but are not limited to the following:
- B. Central Building Automation System including packaged unitary controllers.
- C. Equipment of the heating, ventilating and air conditioning systems.

1.4 OVERVIEW OF CONTRACTOR'S RESPONSIBILITIES

- A. Perform commissioning inspections and tests at the direction of the CxA.
- B. Attend construction phase controls coordination meeting.
- C. Attend testing, adjusting, and balancing (TAB) review and coordination meetings.
- D. Participate in HVAC systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- E. Provide information requested by the CxA for final commissioning documentation.
- F. Provide measuring instruments and logging devices to record test data and provide data acquisition equipment to record data for the complete range of testing for the required test period.
- G. Provide detailed startup procedures.

- H. Provide copies of all submittals, including all changes thereto, with details as required in the appropriate subsection of 3.1 Responsibilities.
- I. Facilitate the coordination of the commissioning process and incorporate commissioning activities into overall project schedule (OPS).
- J. Ensure all subcontractors and vendors execute their commissioning responsibilities according to the contract documents and the OPS.
- K. Provide required demonstration and training of owner's personnel.
- L. Review and accept construction checklists provided by commissioning authority (CxA).
- M. Prepare O&M manuals, according to the contract documents, including clarifying and updating the original sequences of operation to as-built/as-tested conditions.
- N. Cooperate with the CxA for resolution of issues recorded in the "Issues Log"
- O. Prepare and provide all documentation as necessary for the compilation of the Systems Manual.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

- A. The HVAC Contractor shall provide all standard testing equipment required to perform startup, initial checkout, and testing requirements of Division 23.
- B. The Controls Contractor shall provide all standard testing equipment required to test the Building Automation and Automatic Temperature Control System (BAS), including calibration of valve and damper actuators and all sensors. Trend logs for functional testing shall be generated through the BAS interface as requested by the CxA.
- C. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the following tolerances. Temperature sensors and digital thermometers shall have a certified calibration, performed within the past year, to an accuracy of 0.5°F and a resolution of ± 0.1 °F. Pressure sensors shall have an accuracy of $\pm 2.0\%$ of the value range being measured (not full range of meter) and have been calibrated within the last year. All equipment shall be calibrated according to the manufacturer's recommended intervals and when dropped or damaged. Calibration tags shall be affixed or certificates readily available.

PART 3 - EXECUTION

3.1 RESPONSIBILITIES

- A. HVAC, Controls and TAB Contractors. The commissioning responsibilities applicable to each of the HVAC, Controls and TAB Contractors of Division 23 are follows:
- B. Attend the initial commissioning meeting conducted at the start of construction, the commissioning meeting held 30 days prior to startup of the primary equipment, and all commissioning team meetings.

- C. Provide a copy of approved shop drawings and startup reports for all commissioned equipment to the CxA. Supplement the shop drawing data with the manufacturer's installation and start-up procedures. This material should be identical to the literature which will be included in the Operation and Maintenance Manuals.
1. The Operation and Maintenance Manuals shall be submitted to the CM prior to the start of training (three (3) weeks before startup and training and at least sixty (60) days before substantial completion).
 2. Perform and document results of Pre-functional Inspections at the direction of the CxA. Ensure that the inspection checklists are completed before startup or as specified by the CxA.
 3. During the startup and initial checkout process, execute all portions of the manufacturer's start-up checklists for all commissioned HVAC equipment.
 4. Perform and clearly document all completed startup and system operational checkout procedures and provide a copy to the CxA.
 5. Perform and document results of equipment functional testing at the direction of the CxA. Ensure that the testing is completed in the timeline specified by the CxA.
 6. Address current A/E punch list items and Commissioning corrective action items on the "Issues Log" before functional testing. Air and water TAB shall be completed, with discrepancies and problems remedied, before functional testing of the respective air-or water-related systems.
 7. Provide skilled technicians to execute starting of equipment and to perform tests in accordance with all Division 23 sections. Where specified, startup shall be performed by a factory authorized service representative. Ensure that they are available and present during the agreed-upon schedules for the sufficient duration to complete the necessary tests, adjustments and problem-solving.
 8. Correct deficiencies (differences between specified and observed performance as interpreted by the CxA and A/E) and retest the equipment.
 9. Provide training of Owner's operating staff as specified in Division 23 Sections. Use expert qualified personnel.
 10. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.
 11. Correct deficiencies and make necessary adjustments to O&M manuals for applicable issues identified in any seasonal testing.
 - a. HVAC Contractor. The responsibilities of the HVAC Contractor, during construction and acceptance phases in addition to those listed in (A) are:
 12. Provide startup for all HVAC equipment.

13. Prepare a preliminary schedule for Division 23 pipe and duct system testing, flushing and cleaning, equipment start-up and TAB start and completion for use by the PM and CxA. Update the schedule as appropriate.
 14. Notify the PM and CxA when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment, and TAB will occur. Be proactive in seeing that commissioning processes are executed and that the CxA has the scheduling information needed to efficiently facilitate the commission process.
 15. Calibrations: The HVAC Contractor is responsible to calibrate all factory-installed sensors and actuators. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated by the HVAC Contractor.
 16. Supervise all commissioning activities executed by subcontractors, including the Controls Contractor.
 17. List and clearly identify on the as-built duct and piping drawings the locations of all flow meters, fire and smoke dampers, duct detectors, temperature sensors, relative humidity sensors, CO2 sensors, static and differential pressure sensors (air, water and building pressure).
 - a. Controls Contractor - The commissioning responsibilities of the Controls Contractor, during construction and acceptance phases in addition to those listed in (A) are:
- D. Sequences of Operation Submittals. The Controls Contractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. The submitted sequences shall generally include the following, but can vary according to project needs:
1. An overview narrative of the system (one or two paragraphs) generally describing its purpose, components and function.
 2. Logic diagrams detailing the flow of information for each control algorithm. These diagrams should include all inputs, outputs, and computations.
 3. All interactions and interlocks with other systems.
 4. Detailed delineation of control between any packaged controls and the building automation system, listing which points the only monitored at the BAS, and which points can be controlled by and adjusted at the BAS.
 5. Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included but will generally require additional narrative).
 6. Start-up sequences.
 7. Warm-up mode sequences.
 8. Normal operating mode sequences.
 9. Unoccupied mode sequences.
 10. Shutdown sequences.
 11. Capacity control sequences and equipment staging.
 12. Temperature and pressure control: setbacks, setups, resets, etc.
 13. Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.

14. Effects of power or equipment failure with all standby component functions.
15. Sequences for all alarms and emergency shut downs.
16. Seasonal operational differences and recommendations.
17. Initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
18. Daily/weekly/monthly schedules, as appropriate, if known.
19. To facilitate referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference. Where possible, the numbering sequence shall correspond with Section 23 0460 Automatic Temperature Controls.

E. Control Drawings Submittal:

1. The control drawings shall have a key to all abbreviations.
2. The control drawings shall contain graphic schematic depictions of the system and each component.
3. The schematics shall include the system and component layout of any equipment that the control system monitors, enables, or controls, even if the equipment is primarily controlled by packaged or integral controls.
4. Provide a full points list with at least the following included for each point:
 - a. Controlled system.
 - b. Point abbreviation
 - c. Point description
 - d. Display unit.
 - e. Control point or setpoint (Yes/No)
 - f. Input point (Yes/No)
 - g. Output point (Yes/No)
5. The controls contractor shall keep the A/E, CxA, HVAC and TAB Contractor informed, in a timely manner, of all changes to this list during programming and setup.

F. Submit a written checkout plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout and adjust the control system prior to functional testing. At minimum, the checkout plan shall include for each type of equipment controlled by the building automation system:

1. System name.
2. List of devices.
3. Step-by-step procedures for testing each controller after installation, including:
 - a. Process of verifying proper hardware and wiring installation.
 - b. Process of downloading programs to local controllers and verifying that they are addressed correctly.
 - c. Process for performing and documenting point-to-point checkout for each digital and analog input and output.
 - d. Process of performing operational checks of each controlled component.
 - e. Plan and process for calibrating valve and damper actuators and all sensors.

- f. A description of the expected field adjustments for transmitter, controllers and control actuators should control responses fall outside of expected values.
 4. A copy of the log and field checkout sheets that will document the process. This log must include a place for initial and final read values during calibration of each point and clearly indicate when a sensor, controller or command has “passed” and is operating within the contract parameters.
 5. A description of the instrumentation required for testing.
 6. Indicate the portion of the controls checkout plan that should be completed prior to TAB using the controls system for TAB work. Coordinate with the CxA and TAB Contractor for this determination.
- G. Point-to-Point Checkout: Include in the checkout plan a point-to-point checkout. Each control point tied to a central control system shall be verified to be commanding, reporting and controlling according to its intended purpose. For each output, commands shall be initiated and verified to be functioning by visually observing and documenting the status of the controlled device in the field (e.g. valve or damper actuator response, pump or fan status). For each input, the system or conditions shall be altered to initiate the input response being tested and the response in the control system observed and recorded (e.g. high duct static pressure alarm).
- H. Calibrations: The Controls Contractor is responsible to calibrate all field installed sensors and actuators using test and documentation methods approved by the CxA. The HVAC Contractor is responsible to calibrate all factory installed sensors and actuators.
1. Sensors installed in the unit at the factory, with a calibration certification provided, need not be field calibrated by the HVAC Contractor.
 2. Valve leak-by tests shall be conducted by the Contractor when shown on a construction checklist.
 3. All procedures used shall be fully documented by the Controls Contractor on suitable forms, clearly referencing the procedures followed and written documentation of initial, intermediate and final results.
- I. Beyond the control points necessary to execute all documented control sequences, provide monitoring, control and virtual points as indicated in the Specifications.
- J. Provide an official notice to proceed to the CxA and project team upon completion of the Building Automation System (BAS) and Automatic Temperature Control System (ATC) installation, including checkout and calibration of each controlled device, to confirm that all system programming is complete as to all respects of the Contract Documents. This shall be submitted by the Controls Contractor prior to the start of functional testing by the CxA.
1. TAB Contractor: The scope of work for the TAB Contractor is provided in Section 230460.

3.1 SUBMITTALS

- A. The Contractor shall send one copy of product data, shop drawings and similar submittals to the CxA at the same time they are submitted to the A/E. The CxA will review the submittals and provide any comments to the A/E for inclusion in their comments. The Architect will transmit to the CxA, for the CxA's use in preparing functional test procedures; one reviewed and approved copy of product data, shop drawings and similar submittals received from the HVAC, Controls and TAB Contractors, pertinent to equipment and systems to be commissioned.

3.2 STARTUP

- A. The HVAC, Controls and TAB Contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section. Equipment start-up is required to complete systems and sub-systems so they are fully functional, in compliance with the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility, or partially shift that responsibility to any extent onto the Commissioning Agent or Owner.
- B. Testing is intended to begin upon completion of a system. Refer to Section 019100 for additional information related to scheduling.

3.3 TESTS

- A. The HVAC and Controls Contractors shall provide the necessary support to the CxA to complete functional testing. The Controls Contractor shall fully test and verify all aspects of the BAS Contract Work on a point / system / integrated operational basis for all points, features and functions specified. The following requirements apply to all mechanical and control systems and features that are to be commissioned when referenced below. Tests shall:
 - B. Verify functionality and compliance with the basis of design for each individual sequence module in the sequence of operations. Verify proper operation of all control strategies, energy efficiency and self-diagnostics features by stepping through each sequence and documenting equipment and system performance. Tests shall include startup, normal operation, shutdown, scheduled 'on' and 'off', unoccupied and manual modes, safeties, alarms, over-rides, lockouts and power failure.
 - C. Verify operation of systems and components that may be impacted during low, normal and high load conditions and during combinations of environmental and interacting equipment conditions that could reasonably exist and potentially result in adverse system reaction.
 - D. Verify all alarm and high and low limit functions and messages generated on all points with alarm settings.
 - E. Verify integrated performance of all components and control system components, including all interlocks and interactions with other equipment and systems.
 - F. Verify shutdown and restart capabilities for both scheduled and unscheduled events (e.g. power failure recovery and normal scheduled start/stop).
 - G. Verify proper sequencing of heat transfer elements as required to prevent simultaneous heating and cooling, unless specifically required for dehumidification operation.

- H. Verify system response and stability of control loops under different load conditions and determine if additional loop tuning is required for dehumidification operation.
- I. When applicable, demonstrate a full cycle from 'off' to 'on' and 'no load' to 'full load' and then to 'no load' and 'off'.
- J. Verify time of day schedules and setpoints.
- K. Verify all energy saving control strategies.
- L. Verify that all control system graphics are complete, that graphics are representative of the systems, and that all points and control elements are shown in the same location on the graphics as they are located in the field.
- M. Verify operation control of all adjustable system control points, including proper access level as agreed to during the controls system demonstration.
 - 1. In addition to specific details, and/or standards referenced for acceptance testing indicated in other Division 23 sections, the following common acceptance criteria shall apply to all mechanical equipment, assemblies, and features:
- N. For the conditions, sequences and modes tested, the equipment, integral components and related equipment shall respond to varying loads and changing conditions and parameters appropriately as expected, according to the sequence of operation, as specified, according to acceptable operating practice and the manufacturer's performance specifications.
- O. Systems shall accomplish their intended function and performance (e.g. provide supply air and water at designated temperature and flow rate, etc., and maintain space conditions in terms of air temperature, relative humidity, and CO2 concentration) at specified levels at varying conditions.
- P. Control loops shall be stable under all operating conditions. Control loops shall exhibit a quarter decay ratio type response to a step change or other upset and return to stable operation in a time frame that is reasonable and realistic for the system that they are associated with.
- Q. Resetting a manual safety shall result in a stable, safe, and predictable return to normal operation by the system.
- R. Safety circuits and permissive control circuits shall function in all possible combinations of selector switch positions (hand, auto, inverter, bypass etc.).
- S. Additional acceptance criteria may be defined by the CxA when detailed tested procedures are developed.
- T. At the CxA's discretion, if large numbers of deficiencies or repeated deficiencies are encountered, the CxA shall suspend functional testing until the Contractor corrects the deficiencies and troubleshoots all remaining systems at issue on their own. The Contractor shall be responsible for any resulting schedule delays that increase the overall time period to complete functional testing.

- U. Retesting: The CxA will direct the retesting of the equipment once at no charge to the Owner for their time. The CxA's time and expenses incurred for a second retest, if required due to no fault of the CxA, will be reviewed by the Owner to determine the appropriate means of compensation to the CxA for extension of services. The functional testing shall include operating the system and components through each of the written sequences of operation, and other significant modes and sequences, including startup, shutdown, unoccupied mode, manual mode, staging, miscellaneous alarms, power failure, security alarm when impacted and interlocks with other systems or equipment. Sensors and actuators shall be calibrated during construction checkout by the installing contractors and spot-checked by the CxA during functional testing.

3.4 WRITTEN WORK PRODUCTS

- A. Written work products of Contractors shall consist of the filled out start-up, initial checkout, and test documentation in accordance with all Division 23 sections.

END OF SECTION 230485

SECTION 260900

GUARANTEE

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

1.1 GUARANTEE

- A. The Contractor shall remove, replace and/or repair at his own expense and at the convenience of the Owner, any defects in workmanship, materials, ratings, capacities and/or characteristics occurring in the work within one (1) year or within such longer period as may be provided in the Drawings and/or Section of the Specifications, which guarantee period shall commence with the final acceptance of the entire Contract in accordance with the guarantee provisions stated in the General Conditions, and the Contractor shall pay for all damage to the system resulting from defects in the work and all expenses necessary to remove, replace, and/or repair any other work which may be damaged in removing, replacing and/or repairing the work.

END OF SECTION 230900

SECTION 260100

GENERAL CONDITIONS

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section.

1.1 DESCRIPTION OF WORK

- A. It is the intention of the Specification and Drawings to call for finish work, tested and ready for operation.
- B. Any apparatus, appliance material or work not shown on the Drawings but mentioned in the Specifications, or vice versa, or any incidental accessories or ancillary devices necessary to make ready for operation even if not particularly specified, shall be furnished, delivered and installed under their respective Division without additional expense to the Owner.
- C. Minor details not usually shown or specified, but necessary for proper installation and operation, shall be included in the work as though they were hereinafter specified or shown.
- D. Work under each section shall include giving written notice to the Architect of any materials or apparatus believed inadequate or unsuitable, in violation of laws, ordinances, rules and regulations of authorities having jurisdiction; and any necessary items of work omitted. In the absence of such written notice, it is mutually agreed that work under each section has included the cost of all necessary items for the approved satisfactory functioning of the entire system without extra compensation.
- E. Small scale drilling through walls and floors which may contain asbestos shall be performed by a person with a "restricted asbestos handler allied trades certificate" and shall have a copy of it in his possession at all times while working of the project.

1.2 DRAWINGS

- A. Drawings are diagrammatic and indicate the general arrangement of the system and work included in the Contract. (Do not scale the drawings). Consult the Architectural Drawings and details for exact location of fixtures and equipment; where same are not definitely located, obtain this information from the general construction supervisor.
- B. Work under each section shall closely follow Drawings in layout of work; check Drawings of other Divisions to verify spaces in which work will be installed. Maintain maximum headroom; do not begin work until unsatisfactory conditions are corrected.
- C. Make reasonable modifications in the layout as needed to prevent conflict with work of other Sections of the Specifications or for proper execution of the work.

- D. It shall be understood that the right is reserved by the Architect/Engineer to change the location of equipment and apparatus to a reasonable extent as building conditions may dictate, prior to their installation without extra cost to the Owner.

1.3 SURVEYS AND MEASUREMENTS

- A. Base all measurements, both horizontal and vertical, from established benchmarks. All work shall agree with these established lines and levels. Verify all measurements at site and check the correctness of same as related to the work.
- B. Before proceeding with the work resolve discrepancies between actual measurements and those indicated, which prevent following good practice or intent of the Drawings or Specifications.

1.4 CODES AND STANDARDS – Coordinate with Division 1

- A. The Codes and Standards listed below apply to all Electrical work codes or standards that are mentioned in these Specifications; the latest edition or revision shall be followed:
 - 1. NEMA - Standards
 - 2. ANSI CI - National Electrical Code (NFPA 70)
 - 3. ANSI C50.13 - Rotating Electrical Machinery
 - 4. NEMA MG2 - Construction and guide for selection, installation and use of electric motors.
 - 5. NEMA MG1 - Motors and Generators
- B. The following State and Local Codes shall apply: New York State Uniform Fire Prevention and Building Code, and Local Building Codes.
- C. The following abbreviations are used within this Division of the Specifications:
 - 1. IES - Illuminating Engineering Society.
 - 2. NEC - National Electrical Code
 - 3. ANSI - American National Standards Institute
 - 4. ASTM - American Society for testing and materials
 - 5. EPA - Environmental Protection Agency
 - 6. IEEE - Institute of Electrical and Electronic Engineers
 - 7. NEMA - National Electrical Manufacturers Association
 - 8. NFPA - National Fire Protection Association.
 - 9. OSHA - Occupational Safety and Health Administration
 - 10. UL - Underwriter's Laboratories

1.5 PERMITS AND FEES

- A. Give all necessary notices, obtain all permits and pay all Government and State sales taxes and fees where applicable, and other costs, including utility connections or extensions in connection with work of this Division. File all necessary plans, prepare all documents and obtain all necessary approvals of all Governmental and State departments having jurisdiction; obtain all necessary certificates of inspections for his work and deliver a copy to the Architect before request for acceptance and final payment for the work. Pay fees for utility construction/connections.

- B. Include in the work, without extra cost to the Owner, any labor, materials, services, and apparatus, Drawings in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on the Drawings and/or specified.
- C. All materials furnished and all work installed shall comply with the rules and recommendations of the National Fire Protection Association, with the requirements of the local utility companies, with the recommendations of fire insurance rating organization having jurisdiction and with the requirements of all governmental departments having jurisdiction.
- D. All materials and equipment for the electrical portion of the mechanical systems shall bear the approval label of or shall be listed by the Underwriter's Laboratories, Inc.

1.6 TEMPORARY LIGHT AND POWER – See Division 1

- A. The Contractor shall furnish, install, maintain and, upon direction to do so, remove system of temporary lighting and power for the use of all construction trades.
- B. The Electrical Contractor shall provide adequate electrical service for the needs of all Contracting Trades.
- C. Wiring shall be provided for temporary use during building construction, including grounding and fused main cut-off switches. Temporary electric lines with branch switches shall be provided for lighting and for taps for electric tools, pumps and other temporary equipment; all connected to a main line looped through floor spaces and up stair wells or shafts. All power outlets shall be grounded to an equipment ground wire in an approved manner. Electric lines shall be extended to power tools, which cannot be located within reach of extension cords.
- D. Light bulbs shall be provided in sufficient quantity to light the building for safety purposes. Extension cords shall be provided as may be essential to the proper execution of the work. Temporary lighting shall be provided for all stairs and other locations where needed for safety or the proper execution of the work.
- E. The Electrical Contractor shall maintain temporary lighting and power systems in good working condition, including the relocation and reinstallation when required to avoid interference with the progress of construction.
- F. Provide ground-fault personnel ampere protection for all single phase, 15 and 20 ampere receptacles. All receptacles and portable cord connectors shall have NEMA standard locking type configurations.
- G. The Electrical Contractor shall turn lights on and off at the beginning and end of each working day of any trade unless otherwise directed. He shall arrange for all temporary light and power for all trades which do not have holidays (days off) similar to the electrical trade. The Electrical Contractor shall patch and repair all openings left damaged by the installation and removal of the temporary light and power.

1.7 MANUFACTURER'S IDENTIFICATION

- A. Manufacturer's nameplate, name or trademark and address shall be attached permanently to all equipment and materials furnished under this Division. The nameplate of a contractor or distributor may not be used.

1.8 SHOP DRAWINGS – See Division 1

- A. Submit for approval detailed shop drawings of all equipment and materials in accordance with working procedures.
- B. Furnish all necessary templates and patterns for installation work and for the purpose of making adjoining work conform; furnish setting plans and shop details to other trades as necessary.
- C. Submit shop drawings for the following:
 - 1. Light fixtures.
 - 2. Receptacles, switches, occupancy sensors.
 - 3. Overcurrent protective devices.
 - 4. Panelboards.
 - 5. P.A. system components.
 - 6. Fire alarm system.

1.9 MATERIALS AND WORKMANSHIP

- A. All materials and apparatus necessary for the work, except as specifically indicated otherwise, shall be new, of first class quality and shall be furnished, delivered, erected, connected and finished in every detail and shall be so selected and arranged as to fit properly into the building spaces. Where no specific kind or quality of material is given, a first class standard article as accepted by the Architect shall be furnished.
- B. Furnish the services of an experienced Superintendent who shall be constantly in charge of the installation of the work, together with all skilled workmen, helpers, and labor to unload, transfer, erect, connect up, adjust, start, operate and test each system.
- C. Unless otherwise specifically indicated on the Drawings or Specifications, all equipment and materials shall be installed in accordance with the recommendations of the manufacturer. This includes the performance of such tests as the manufacturer recommends.

1.10 PROTECTION

- A. Work under each Section shall include protecting the work and materials of all other Sections from damage from work or workmen and shall include making good all damage thus caused. Be responsible for work and equipment until finally inspected, tested, and accepted; protect work against theft, injury or damage; and carefully store material and equipment received on site, which is not immediately installed. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing or other foreign material.

- B. Work under each section includes receiving, unloading, uncrating, storing, protecting, setting in place and connecting up completely of any equipment supplied under each section. Work under each section shall also include exercising special care in handling and protecting equipment and fixtures and shall include the cost of replacing any of the above equipment and fixtures which are missing or damaged by reason of mishandling or failure to protect on the part of the Contractor.

1.11 BASES AND SUPPORTS

- A. Unless specifically noted otherwise, provide all necessary supports, pads, bases, and piers required for all equipment under this Division. Provide all temporary bases and supports as required.
- B. All equipment, unless shown otherwise, shall be securely attached to the building structure. Attachments shall be of a strong and durable nature; any attachments that are, insufficient, shall be replaced as directed by the Architect.

1.12 SLEEVES, INSERTS AND ANCHOR BOLTS

- A. All conduits passing through floors, walls or partitions shall be provided with sleeves having an internal diameter one inch larger than the outside diameter of the conduit, or insulation enclosing the conduit.
- B. Furnish all sleeves, inserts, and anchor bolts necessary to be installed under other sections of the Specifications to accommodate work of this section.
- C. Sleeves through outside walls shall be cast iron sleeves with intermediate integral flange. Sleeves shall be set with ends flush with each face of wall. The remaining space shall be packed with oakum to within 2 inches of each face of the wall. The remaining shall be packed and made watertight with a waterproof compound.
- D. Sleeves through concrete floors or interior masonry walls shall be schedule 40 black steel pipe, set flush with finished walls or ceiling surfaces but extending 2 inches above finished floors.
- E. Sleeves through interior partitions shall be 22 gauge galvanized sheet steel, set flush with finished surfaces or partitions.
- F. Inserts shall be individual or strip type of pressed steel construction with accommodation for removable nuts and threaded rods up to 3/4" inch diameter, permitting lateral adjustment. Individual inserts shall have an opening at the top to allow reinforcing rods up to 1/2" diameter to be passed through the insert body. Strip inserts shall have attached rods having hooked ends to allow fastening to reinforcing rods. Inserts shall be as manufactured by Carpenter and Patterson, Inc. or Grinnell Co., Inc.
- G. Penetrations through fire-rated walls, ceilings and floors in which cables, conduits pass, shall be sealed by a UL approved fire stop fitting classified for an hourly rating equal to the fire rating of the floor, wall or ceiling shall be Gedney Fire Seal Type CFSF of CAPS.

- 1.13 PAINTING – See Division 1; all work required shall be performed by this Contractor.
- A. All finish painting in finished areas shall be performed by others.
 - B. All materials shipped to the job site under the Division, such as panels and plates, shall have a prime coat and standard manufacturer's finish unless otherwise specified.
 - C. Inaccessible conduits, hangers, supports and anchors and ducts shall be coated prior to installing.
 - D. All components of the fire alarm system raceway shall be painted red. This includes but is not limited to conduit, junction boxes, pull boxes.
- 1.14 CUTTING AND PATCHING – See Division 1
- A. All cutting and patching required for the work of this Division shall be done by this Division.
 - B. Work under this Division shall include furnishing, locating and setting inserts and/or sleeves. Do all drilling and cutting necessary for the installation.
 - C. All holes cut through concrete slabs and structural steel shall be punched or drilled from the underside. No structural member shall be cut without the written acceptance of the Architect and all such cutting shall be done in a manner directed by him.
 - D. Refer to Division 1 for additional requirements.
- 1.15 SCAFFOLDING, RIGGING AND HOISTING – Coordinate with Division 1
- A. Furnish all scaffolding, rigging, hoisting, and services necessary for erection and delivery into the premises of any equipment and apparatus furnished under this Division. Remove same from premises when no longer needed.
- 1.16 EXCAVATING AND BACKFILLING
- A. All excavation and backfilling for the work of this Division shall be performed by Division 2.
- 1.17 WATERPROOFING
- A. Where any work penetrates waterproofing, including waterproof concrete and floors in wet areas. Submit proposed method of installation for review by the Architect before beginning work. Furnish all necessary sleeves, caulking and flashing necessary to make opening absolutely watertight.
- 1.18 ACCESSIBILITY AND ACCESS PANELS
- A. Be responsible for the sufficiency of the size of shafts and chases, the adequate thickness of partitions, and the adequate clearance in double partitions and hung ceilings for the proper installation of the work of this Division.

- B. Locate all equipment, which must be serviced, operated or maintained in fully accessible positions. Minor deviations from Drawings may be allowed for better accessibility with approval of the Architect.
- 1.19 SHUTDOWNS – See Division 1
- 1.20 CLEANING - Coordinate with Division 1
- A. Thoroughly clean all equipment of all foreign substances inside and out before being placed in operation.
 - B. If any foreign matter should stop any part of a system after being placed in operation, the system shall be disconnected, cleaned and reconnected whenever necessary to locate and remove obstructions. Any work damaged in the course of removing obstructions shall be repaired or replaced when the system is reconnected at no additional cost to the Owner.
 - C. Upon completion of work remove from the premises all rubbish, debris, and excess materials. Any oil or grease stains on floor areas caused by work of this Division shall be removed and floor areas left clean.
- 1.21 RECORD DRAWINGS – Work shall be governed by requirements set forth in Division 1
- A. Maintain at the job site a record set of Electrical Drawings on which any changes in location of equipment, panels, devices, and major conduits shall be recorded. Indicate dimensions of all items installed underground or in concrete.
- 1.22 OPERATING INSTRUCTIONS – Coordinate with requirements set forth in Division 1
- A. Upon completion of all work and all tests, the Contractor shall furnish the necessary skilled labor and helpers for operating his system and equipment for a period specified under each applicable Section of this Division. During this period, he shall instruct the Owner or his representative fully in the operation, adjustment and maintenance of all equipment furnished. Give at least 7 days' notice to the Owner in advance of this period.
 - B. The manufacturer shall attest in writing that his equipment has been properly installed prior to start. The following is some of the equipment necessary for this inspection: fire alarm system. These letters will be bound into the operating and maintenance books.
- 1.23 ADJUSTING AND TESTING
- A. After all equipment and accessories to be furnished are in place, they shall be put in final adjustment and subjected to such operating tests as will assure the Architect that they are in proper adjustment and in satisfactory permanent operating condition.
 - B. This particular work shall include the services of a factory engineer to inspect the installation and assist in the initial startup and adjustment to the equipment. The period of these services shall be for such time as necessary to secure proper installation and adjustments. After the equipment is placed in permanent operation, there shall be furnished the service of said engineer for the purpose of supervising the initial operation of the equipment and to instruct the personnel responsible for operation and maintenance of the equipment.

- C. At the completion of the job when all panels, devices, etc. are at full working load the Contractor shall provide infrared scan thermographic inspection test of all connection points, terminals, etc. of wires #8 AWG and larger to detect "hot-spots" in the electrical current flow. Correct all hot-spots.

1.24 UNDERWRITER'S LABEL

- A. All electrical equipment and materials shall be new and shall comply with the standards of and shall bear the label of the Underwriter's Laboratories.

1.25 ELECTRICAL SAFETY INSPECTION

- A. Electrical Contractor shall arrange for an Electrical Safety Inspection to be performed by the Local Inspection Agency (i.e.: New York Electrical Inspection Services, Atlantic Inland, Middle Department Inspection Agency). A Certificate of Compliance "Underwriter's Certificate" shall be issued to the Owner. All costs and coordination required shall be included in this Contractors Base Bid.

1.26 REMOVALS – Coordinate with Division 1 and Division 2

- A. The scope of removals shown on the Drawings are diagrammatic only and indicate the intent of the work to be performed and not the complete scope of demolition and/or removal work. It shall be the responsibility of this Contractor to remove any electrical devices even if not specifically indicated to be removed on these Drawings in order to accommodate new work.
- B. All power conductors, control wiring and conduit associated with mechanical equipment such as fans, pumps, etc. designated for removal on the HVAC Drawings shall be removed clear back to the source of power and disconnected. All motor starters, disconnect switches, control devices, etc. shall be removed. Refer to HVAC Drawings for extent of HVAC removals.
- C. Any device removed shall include (but shall not be limited to) the removal of all associated wiring, conduit, boxes, and auxiliary devices back to the previous device on the circuit, or back to the panelboard or origin of the circuit or any other items that are not incorporated in new layout, until such removal is complete. If the removal of any device interrupts service of any other device that is to remain, the Contractor shall provide all materials and labor to ensure continuity of service to those devices to remain.
- D. Junction boxes, pullboxes, wireways, conduits, or any other devices required to reconnect circuitry shall be installed concealed within the ceilings, partitions and/or walls, floors, no surface or exposed circuiting shall be permitted, unless specifically indicated.
- E. The Electrical Contractor shall patch all openings in walls, ceilings or roof that are left open as a result of removals. Refer to cutting and patching section.
- F. Any electrical device removed including but not limited to disconnect switches, panelboards, etc. shall be cleaned, protected and turned over to the Owner or disposed of as directed by Owner.

END OF SECTION 260110

SECTION 260125

SCOPE OF WORK

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

1.1 SCOPE OF WORK

- A. The work under this section includes all labor, materials, equipment, tools, transportation and the performance of all work necessary and required for furnishing and installing all Electrical work shown on the Contract Documents, as specified herein and as otherwise required by job conditions or reasonably implied, including, but not necessarily limited to the following:
1. The addition of new fire alarm devices (i.e., automatic fan shutdown, for new HVAC equipment) and the replacement of the existing ones as shown on Drawings.
 2. The contractor shall dispose of all debris, including but not limited to fixtures, equipment, lamps, ballast, wiring devices and the like in accordance with, as defined by governing law and regulations of the jurisdiction where the work is being performed.
 3. Modifications to existing electrical distribution system as indicated on the Drawings.
 4. Distribution panelboard, circuit breaker panelboards, feeder, conduit, cables and branch circuit wiring with all connections complete.
 5. Conduit, conduit fittings, junction and pull boxes and all appurtenances necessary for the raceway systems including necessary supports and fasteners.
 6. Electrical conductors, connectors, fittings and connection lugs.
 7. Branch circuit devices, outlet boxes, pull boxes, motor disconnect switches, etc.
 8. Power wiring to HVAC and Plumbing equipment including disconnect switches as shown and/or required by NEC.
 9. Variable Frequency Drives/Motor Starter shall be furnished by Mechanical Contractor and installed by electrical contractor.
 10. Empty conduit for computer and telephone.
 11. Lighting fixtures, lamps and occupancy sensor.
 12. Public address speakers.
 13. Core drilled holes for conduit passing through walls, ceilings and floors.

14. All necessary cutting, patching and core drilling incidental to the electrical work.
15. Temporary light and power.
16. Licenses, permits, inspection and approvals.
17. Grounding as required as per NEC.
18. Sleeves for conduit and watertight caulking between conduit and sleeve.
19. Testing.
20. Cutting, patching and drilling.
21. Excavation and backfill by others. Sand bedding by Electrical Contractor.

- B. Coordination Drawings (if applicable): Attention is directed to Division 1 for coordination drawing requirements for this project. These drawings are critical to the proper execution of the work and failure to honor these requirements may become the basis for denial of any and all claims for either or both "time" and "money".

1.2 WORK NOT INCLUDED

- A. The following related items will be done by others:
1. Furnishing motors and controllers.
 2. Concrete work.
 3. Excavation and backfill.

END OF SECTION 260125

SECTION 260150

APPROVED MANUFACTURERS

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

1.1 APPROVED MANUFACTURERS

A. The following list of manufacturers constitutes an approved list:

- | | | |
|-----|--------------------------|---------------------------------------|
| 1. | Panelboards | Siemens, Square D, GE |
| 2. | Disconnect Switches | Siemens, Square D, GE |
| 3. | Conduit (steel) | Wheatland, Allied, Republic Conduit |
| 4. | Conduit Fittings (steel) | Appleton, Crouse-Hind, O-Z, T&B, M&W |
| 5. | Wire and Cable | General, South Wire, Rome, Cerro |
| 6. | Splicing Connectors | 3M, O-Z, Thomas & Betts |
| 7. | Outlet Boxes | Appleton, National, Steel City, Racor |
| 8. | Wiring Devices | Arrow-Hart, Hubbell, P & S |
| 9. | Fuses | Bussman, Ferraz-Shawmut, Littelfuse |
| 10. | Lamp | GE, Sylvania, Philips |
| 11. | Motion Sensors | Watt Stopper, Sensorswitch |
| 13. | Fire Alarm System | Silent Knight or approved equal |
| 14. | Public Address system | Rauland-Borg, Bogen or approved equal |

B. All materials and appliances shall have listing of Underwriters Laboratories, Inc. and be so labeled, or shall conform to their requirements, in which case certified statements to that effect shall be furnished by the manufacturer with a copy of an examination report by a recognized independent testing laboratory acceptable to the Architect and his Engineer. Use new materials and appliances throughout.

C. Where several types or makes of materials are specified, the Contractor has the option of using any of these, but after a type or make has been selected and has received the approval of the Architect, it shall be used throughout.

- D. The Contractor shall provide all structural supports for the proper attachment of equipment supplied by him and also for all equipment supplied to him under other sections of the Specifications for mounting and connections.
- E. Secure all equipment to the building structure independently. Do not secure to work of other trades such as ceiling lath, piping racks, etc., unless specified or noted otherwise.
- F. Wall mounted equipment shall be directly secured to wall by means of steel bolts. Maintain at least 1/4" air space between equipment and supporting wall. Pre-fabricated steel channels providing a high degree of mounting flexibility, such as those manufactured by Kindorf and Unistrut, shall be used for mounting arrays of equipment.
- G. All fastening, supports, hangers, anchors, etc., shall be of a type made for the specific purpose. On masonry walls, metallic expansion shield and machine screws shall be used. Screws with wooden plugs or anchors will not be acceptable on any part of the work.

END OF SECTION 260150

SECTION 260200

CONDUIT

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

- A. The work under this section shall include the furnishing of all material, labor, tools and services necessary to install rigid metal conduit, electrical metallic tubing and liquid tight flexible metal conduit, including all fittings to complete all work shown on the Drawings or specified herein.

1.2 RELATED WORK

- A. Cutting and patching.
- B. Trenching: Excavation and backfill for conduit and utility on site.
- C. Sheet metal flashing and trim.

1.3 REFERENCE FOR METAL RACEWAY

- A. UL 5 - Surface Metal Raceways and Fittings.
- B. UL 870 - Wireways, Auxiliary Gutters, and Associated Fittings.

PART 2 - PRODUCTS

2.1 RIGID STEEL CONDUIT

- A. Industry standard heavy wall conduit.
- B. Minimum 3/4" trade size.
- C. Threaded.
- D. Hot dipped galvanized finish by means of plating after cutting of threads.

2.2 INTERMEDIATE METAL CONDUIT

- A. Industry standard steel conduit.
- B. Minimum 3/4" trade size.
- C. Threaded.
- D. Hot dipped galvanized finish by means of plating after cutting of threads.

2.3 ELECTRICAL METALLIC TUBING

- A. Industry standard thin wall conduit of galvanized steel only.
- B. Minimum 3/4" trade size.
- C. Maximum 4" trade size.

2.4 FLEXIBLE METAL CONDUIT

- A. Galvanized steel tape formed into an industry standard interlocking coil.
- B. Minimum 3/4" trade size except for connection of lighting fixtures.
- C. Grounding type.
- D. Separate ground conductor.
- E. Use for short connections to motor terminal box, other vibrating equipment using a minimum length of 18" with 50% slack and a maximum of 6'.
- F. From outlet box to recessed lighting fixtures with a maximum length of 6'.

2.5 WIREWAYS

- A. Lay-in type, UL listed as wireway or auxiliary gutter.
- B. Wireway shall be of code gauge steel construction (UL standard for Wireway Auxiliary Gutters and Associated Fittings) with removable cover. Tamperproof screws shall be provided for sealing covers to prevent access by unauthorized personnel. Wireway shall be provided with knockouts.
- C. Connector and covers shall be attached so that removal of connectors is not necessary to utilize the lay-in feature.
- D. Finish: All sheet metal parts shall be provided with a rust inhibiting phosphating coating and baked enamel finish. All hardware shall be plated to prevent corrosion. All screws extending into the wireway shall be protected by spring nuts or otherwise guarded to prevent wire insulation damage.

2.6 CONDUIT SUPPORTS

- A. Conduit clamps, straps and supports: Steel or malleable iron.

2.7 CONDUIT FITTINGS

- A. Use compression fittings for all EMT in exposed areas. Utilize set screw fittings only above hung ceilings and concealed areas.

2.8 SURFACE METAL RACEWAY

- A. Metal raceway shall be of a two-piece design with a base and snap-on cover.
- B. Raceway and all components shall be listed by Underwriters Laboratories
- C. Single Channel: Steel, zinc plated, off-white finish suitable for repainting. Two piece design with metal base and snap-on cover. Wire Mold V700, Hubbell Inc. 750 Series, or Panduit PMR5/PMR7
- D. Dual Channel: Steel, galvanized, off-white finish but suitable for repainting. Two-piece design with metal base and snap-on cover, minimum 0.04" thick base and cover. Base shall be divided by a removable barrier section. Provide duplex receptacles mounted in top cell and communication outlets in the bottom cell. Coordinate communications jack requirements with owner's IT personnel. Wiremold V4000, Wiremold DS4000 Series, Hubbell Inc. 4000 Series or Panduit PMR40.

PART 3 - EXECUTION

3.1 CONDUIT SIZING, ARRANGEMENT AND SUPPORT

- A. Minimum size - 3/4". Provide grounding bushings on all conduits 1-1/4" and larger.
- B. Arrange conduit to maintain headroom and present a neat appearance.
- C. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.
- D. Draw up couplings and fittings full and tight. Protect threads cut in field from corrosion. Paint newly threaded joints of steel conduit with T & B "Kopershield" compound before installation. Running threads prohibited; use three-piece unions or split couplings instead. Use only compression fittings for all EMT in areas where it will be exposed in finished and unfinished areas. Provide set screw fittings only when installed above hung ceilings.
- E. Maintain minimum 6-inch clearance between conduit and piping. Maintain 12-inch clearance between conduit and heat sources such as flues; steam pipes and heating appliances.
- F. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers.
- G. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.
- H. Do not fasten conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction, before conductors are pulled.
- I. Exposed conduit on ceiling shall be parallel or perpendicular to wall and vice versa to ceiling when installed on wall. Secure conduit clamps and supports to masonry materials by toggle bolt, expansion bolt or steel insert. Spacing of conduit supports shall not exceed 7 feet.

3.2 CONDUIT INSTALLATION

- A. Cut conduit square using a saw or pipe cutter, Deburr cut ends.
- B. Bring conduit to the shoulder of fittings and couplings and fasten securely.
- C. Use conduit hubs or sealing locknuts for fastening conduit to cast boxes and for fastening conduit to sheet metal boxes in damp or wet locations.
- D. Install no more than the equivalent of three 90-degree bends between boxes.
- E. Use conduit bodies to make sharp changes in direction, as around beams.
- F. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2-inch size.
- G. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
- H. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.
- I. Provide No. 12 AWG insulated conductor or suitable pull string in empty conduit, except sleeves and nipples.
- J. Install expansion-deflection joints where conduit crosses building expansion or seismic joints.
- K. Where conduit penetrates fire-rated walls and floors, provide pipe sleeves two sizes larger than conduit; Pack void around conduit with fire-stop fittings with UL listed fire rating equal to wall or floor ratings; Seal opening around conduit with UL listed foamed silicone elastomer compound.
- L. Installation of conduit in slab shall comply with ACI 318.
- M. Route conduit through roof openings for piping and duct work where possible; otherwise, route through roof with pitch pocket.
- N. Maximum size conduit in slabs above grade: 1 inch. Do not route conduits to cross each other in slabs above grade. Conduits crossing each other may not be larger than 3/4 inch.
- O. All conduit used for fire alarm system shall be painted red.
- P. For Surface Metal Raceway
 - 1. When installing surface metal raceway contractor shall provide boxes from the same manufacturer of the surface metal raceway.
 - 2. Install separate grounding conductor. Grounding conductors for surface metal raceways.

3. Surface metallic raceways in close proximity of other trades, shall be arranged to allow for proper clearance for servicing and headroom. Surface metallic raceway shall be installed parallel to walls, floors and ceilings in a neat workmanlike manner.

3.3 CONDUIT INSTALLATION OF SCHEDULE

- A. Underground installations: PVC minimum Schedule 40, unless otherwise noted on Drawings.
- B. Installations in or under concrete slab: PVC minimum Schedule 40, unless otherwise noted on Drawings.
- C. Exposed outdoor locations: Rigid galvanized steel conduit.
- D. Wet interior locations: Rigid galvanized steel conduit.
- E. Concealed dry interior locations and above accessible ceiling for receptacle and lighting branch wiring: Electrical metallic tubing up to first junction box and flexible metallic tubing (MC cable only) thereafter.
- F. Concealed dry interior locations other than receptacle and lighting branch wiring: Electrical metallic tubing.
- G. Concealed dry interior locations and above accessible ceiling for fire alarm runs: Fire alarm armored cable type MC with red stripe as manufactured by AFC series 1800.
- H. Concealed and exposed dry interior location for feeder runs: Electric metallic tubing.
- I. Exposed dry interior in unfinished locations other than Boiler Rooms: Electric metallic tubing.
- J. Final connections to motors: Flexible metallic tubing (MC cable). Minimum of 10" to maximum of 6' for connections to motors.
- K. Existing exposed dry interior locations (finished spaces), for branch wiring and fire alarm wiring, one-piece steel raceway (similar to Wiremold V-500, V-700).
- L. Final connections to motors: Flexible metallic tubing (MC cable). Minimum of 18" to maximum of 6' for connections to motors.
- M. All conduit installed in boiler room up to 10'-0" AFF and lower shall be rigid galvanized steel conduit. All conduit above 10'-0" shall be electric metallic tubing.
- N. Final connections to equipment and/or motors in boiler room, outdoors and potentially wet indoor areas: liquid tight, flexible; minimum of 18" to maximum 6'-0" connections.

END OF SECTION 260200

SECTION 260300

WIRE AND CABLE

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

- A. The work under this section shall include the furnishing of all material, labor, tools and services necessary to wire and cable in raceway specified in other sections to complete all work shown on the Drawings or specified herein.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Thermoplastic-insulated building wire: Type THHN.
- B. Rubber insulated building wire: NEMA WC 3.
- C. Feeders and branch circuits larger than number 6 AWG: Copper, stranded conductor, 600 volt insulation, type THHN.
- D. Feeder and branch circuits 6 AWG and smaller: Copper conductor, 600 volt insulation, THWN/THHN, 6 and 8 AWG, stranded conductor; Smaller than 8 AWG, solid conductor.
- E. Service feeders and branch circuits in conduit in contact with earth shall be type XHHW.
- F. Control circuits: Copper, stranded conductor 600 volt insulation, THHN.

2.2 ARMORED CABLE

- A. BX or pre-manufactured cables are not acceptable except for Type MC for branch wiring after the first junction box (for receptacle and lighting branch circuits) and final connections to motors in interior dry accessible locations, minimum length shall be 18" with a maximum length of 6' for motors. Except for outdoor and boiler room equipment and/or motors. Provide flexible liquid tight conduit.
- B. Type MC fire alarm cable with red stripe for concealed fire alarm wiring as manufactured by AFC series 1800.
- C. Armored cable, Type MC size 14 through 6 AWG: Copper conductor, 600 volt thermoplastic insulation, rated 90 degrees C., with separate green ground conductor.

2.3 REMOTE CONTROL AND SIGNAL CABLE

- A. Control cable for class 2 or class 3 remote control and signal circuits:

- B. Copper conductor, 300 volt insulation, rated 60 degree C, individual conductors twisted together shielded and covered with a nonmetallic jacket; UL listed for use in air handling ducts, hollow spaces used as ducts and plenums. Verify wiring type with manufacturer.

2.4 COLOR CODING

- A. All wiring shall be color-coded. Neutral wire shall be white throughout and each phase wire shall be identified any place in the system by its color code. All conductors in panel boxes and junction boxes shall be properly tagged with red non-flammable tags properly attached.
- B. Wire shall be color coded as follows:

<u>120/208 volt system</u>		<u>480/277 volt system</u>		<u>Fire Alarm</u>
A Phase	Black	A Phase	Brown	Red
B Phase	Red	B Phase	Orange	
C Phase	Blue	C Phase	Yellow	

Equipment ground wires or ground jumpers shall be Green.

- C. In addition to the basic color-coding described the following additional identification and tagging shall apply.
 1. The switch legs for the local wall switches and in switch panel shall have distinctive stripes. In instances where color-coding is not practicable, such as short runs of heavy feeder cables, taping the ends of the cable with coded colors as indicated above or tagging will be permitted.
 2. Cables shall be tagged in all pull boxes, wireways and wiring gutters of panels.
 3. Where two (2) or more circuits run to or through a control device, outlet box or junction box, each circuit shall be tagged as a guide in making connections.
 4. Tags shall identify wire or cable by number and/or piece of equipment served as shown on the Drawings.

PART 3 - EXECUTION

3.1 GENERAL WIRING METHODS

- A. Use no wire smaller than 12 AWG for power and lighting circuits, and no smaller than 14 AWG for control wiring.
- B. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet and for 20 ampere.
- C. Use 10 AWG conductor for 20 ampere, 277 volt branch circuit home runs longer than 200 feet for 20 ampere.

- D. Place an equal number of conductors for each phase of a circuit in same raceway or cable. No more than one of each phase shall be supported by a single neutral.
- E. Splice only in junction or outlet boxes.
- F. Neatly tag, identify, train and lace wiring inside boxes, equipment and panelboards.
- G. Make conductor lengths for parallel circuits equal.

3.2 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricate for pulling 4 AWG and larger wires.
- B. Completely and thoroughly swab raceway system before installing conductors.
- C. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

3.3 CABLE INSTALLATION

- A. Support cables above accessible ceilings; do not rest on ceiling tiles. Use spring metal clips or metal cable ties to support cables from structure (not ceiling suspension system). Include bridle rings or drive rings.
- B. Use suitable cable fitting and connectors.

3.4 WIRING CONNECTIONS AND TERMINATIONS

- A. Splice only in accessible junction boxes.
- B. Use solderless pressure connections with insulating covers for copper wire splices and tape, 8 AWG and smaller. For 10 AWG and smaller, use insulated spring wire connectors with plastic caps.
- C. Provide extended gutters and tap blocks or pull boxes with tap rail systems similar to Burndy MT Series or Burndy Electrorail system for wire splices 6 AWG and larger.
- D. Tape uninsulated conductors with electrical tape to 150 percent of the insulation value of conductor.
- E. Thoroughly clean wires before installing lugs and connectors.
- F. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.
- G. Terminate spare conductors with electrical tape.

3.5 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of the Specifications.
- B. Inspect wire and cable for physical damage and proper connection.
- C. Torque test conductor connections and terminations to manufacturer's recommended values.
- D. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

3.6 WIRE AND CABLE INSTALLATION SCHEDULE

- A. All wiring and cable shall be installed in conduit unless otherwise noted. Refer to conduit section 260200 for conduit types at various locations.

END OF SECTION 260300

SECTION 260320

OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

- A. Work of this section includes all labor, materials, equipment and services necessary to complete the electrical work as shown on the Drawings and specified herein, including, but not limited to, the following:
- B. Fuses
 - 1. Current limiting cartridge fuses.
 - 2. Time delay cartridge fuses.
- C. Circuit Breakers
 - 1. Standard molded case circuit breakers "bolted in" type.
 - 2. Solid state circuit breakers.
 - 3. Current limiting circuit breakers.
 - 4. Enclosed circuit breakers.

1.2 SUBMITTALS

- A. Shop drawings showing dimensions, location of equipment and method of installation.
- B. Product Data: Manufacturer's printed data, catalog cuts.

1.3 DISCONNECT SWITCHES

- A. Fusible switch assemblies: Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover when switch is in ON position. Handle lockable in OFF position. Fuse clips shall be designed to accommodate Class R, J fuses.
- B. Non-fusible switch assemblies: Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover when switch is in ON position. Handle lockable in OFF position.
- C. Enclosures: NEMA Type 1, 3R or 4 as required.

1.4 FUSES

- A. Voltage ratings of fuses shall be suitable for the supply characteristics to which they are applied.
- B. Fuse type and size shall be suitable for installation in related disconnect switch or circuit breaker.

C. Current limiting fuses shall be as follows:

1. Regardless of actual available fault current, they shall, at full recovery voltage, be capable of safely interrupting fault currents of 200,000 amperes RMS symmetrical or 280,000 amperes RMS asymmetrical, deliverable at the line side of the fuse.
2. They shall have average melting time-current characteristics to meet the Underwriters' Laboratories requirements for "Class RK-1" 0-600 amp fuses.

D. Regardless of actual available fault current, they shall be capable of limiting peak let through current to the following values based on 200,000 amperes RMS symmetrical or 280,000 amperes asymmetrical being available:

<u>Rating In Amperes</u>	<u>Peak Let Through Current In Amps</u>
15-30	6,000
35-50	8,000
70-100	12,000
125-200	20,000
225-601	38,000

E. Fuses shall be rejection type. Fuse clip shall be rejection type.

F. Fuse Type and Application Table:

<u>Category of Application</u>	<u>Acceptable Fuse Types</u> (Bussman Designations @ 600V)
Motor feeder	LPS below 600A
Power panel feeders	LPS below 600A
Safety switches	LPS

1.5 CIRCUIT BREAKERS

- A. "Bolted-In" type, manually operated, quick-make, quick-break, mechanically trip-free operating mechanisms for simultaneous operation, of all poles, with contacts, arc interrupters and trip elements for each pole. "Plug-in" breakers are not permitted. New circuit breakers to be installed in existing panelboards shall be U.L. certified for installation in those panelboards and be labeled with make and model.
- B. Tripping units shall be "thermal-magnetic" type having bimetallic elements for time delay overload protection, and magnetic elements for short circuit protection.
- C. Manually operable by mean of toggle type operating handles having tripped positions midway between the "on-off" position. Handle to be clearly labeled as to breaker rating.
- D. Minimum frame size for all circuit breakers, 1, 2, or 3 pole shall be 100 amperes.
- E. Their interrupting rating shall not be less than 25,000 amperes RMS symmetrical at 208 volt for distribution panels and 10,000 amperes for power panels.

1.6 APPLICATIONS

A. Category of Application for Fuses:

1. Feeders on switchboards.
2. Branch fused switch unit in distribution panel.
3. Fused safety switch.
4. Combination motor starters.

B. Category of Application for Circuit Breakers:

1. Panelboards.
2. Switchboards.
3. Individual enclosures.
4. Combination motor starters.

1.7 SPARE FUSES

- A. Upon Engineer's acceptance of the electrical distribution system, provide spare fuses as follows: 10% of each type and rating installed 600 amperes and smaller (minimum of 3). Provide spare fuse cabinet with directory to store all spare fuses. Locate as directed by Engineer and/or Owner.

1.8 APPROVED MANUFACTURERS

- A. Fuses: Bussman, Ferraz-Shawmut.
- B. Circuit Breakers: Siemens, General Electric, Square D.

1.9 INSTALLATION

- A. All material installation shall be in accordance with manufacturer recommendations and the provisions of all applicable codes.
- B. All fuses and circuit breakers shall be selectively coordinated.
- C. Install disconnect switches where indicated on Drawings.
- D. Install fuses in fusible disconnect switches.
- E. Disconnects shall have NEMA 3R enclosure.

1.10 RECORD DRAWINGS

- A. Shop drawings showing dimensions, location of equipment and method of installation.
- B. Product Data: Manufacturer's printed data, catalog cuts, performance curves.

END OF SECTION 260320

SECTION 260350

BOXES

PART 1 – GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

A. WORK INCLUDED

- B. The work under this section shall include the furnishing of all material, labor, tools and services necessary to install wall and ceiling outlet boxes, floor boxes, pull and junction boxes to complete all work shown on the Drawings or specified herein.

1.2 RELATED WORK

- A. Access doors.
- B. Wiring devices: Service fittings and fire-rated poke-through fittings for floor boxes.
- C. Cabinets and enclosures.

PART 2 – PRODUCTS

2.1 OUTLET BOXES

- A. Sheet metal outlet boxes: ANSI/NEMA OS 1; Galvanized steel, with ½ inch male fixture studs where required.
- B. Cast boxes: Cast fer alloy, deep type, gasketed cover, threaded hubs.
- C. Typical receptacle box shall be 4" square metal boxes, 30.8 cubic inch capacity with brackets as required. Provide 4" square raised device covers.

2.2 PULL AND JUNCTION BOXES

- A. Sheet metal boxes: ANSI/NEMA OS 1; Galvanized steel.
- B. Sheet metal boxes larger than 12 inches in any dimension: hinged enclosure in accordance with Section 260450.
- C. Cast metal boxes for outdoor and wet location installations: NEMA 250; Type 4 and type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
- D. Cast metal boxes for underground installation: NEMA 250; Type 4, inside flanged, recessed cover box for flush mounting, UL listed as raintight. Galvanized cast iron box and plain cover with neoprene gasket and stainless cover screws.

PART 3 – EXECUTION

3.1 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as required in excess of that shown on Drawings and as required for splices, taps, wire pulling, equipment connections and code compliance.
- B. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.
- C. Locate and install boxes to allow access. Where installations are accessible, coordinate locations and sizes of required access doors with Division 1.
- D. Locate and install to maintain headroom and to present neat appearance.

3.2 OUTLET BOX INSTALLATION

- A. Do not install boxes back-to-back in walls. Provide minimum 6 inch separation, except provide minimum 24 inch separation in acoustic-rated walls.
- B. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.
- C. Provide knockout closures for unused openings.
- D. Support boxes independently of conduit except for cast iron boxes that are connected of rigid metal conduits, both supported within 12 inches of box.
- E. Use multiple-gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- F. Install boxes in wall without damaging wall insulation.
- G. Coordinate mounting heights and locations of outlets mounted above counters, benches and backspaces.
- H. Position outlets to locate luminaries as shown on reflected ceiling plans.
- I. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.
- J. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
- K. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- L. Provide cast outlet boxes in exterior locations exposed to the weather and wet locations.

M. PULL AND JUNCTION BOX INSTALLATION

N. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.

O. Support pull and junction boxes independent of conduit.

P. FLOOR BOX INSTALLATION

Q. Set boxes level and flush with finish flooring material.

R. Use cast iron floor boxes for installation in slab on grade.

END OF SECTION 260350

SECTION 260400

WIRING DEVICES

PART 1 – GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

- A. The work under this section shall include the furnishing of all materials, labor, tools and services necessary to install receptacles, service fittings device plates and box covers to complete all work shown on the Drawings or specified herein.

1.2 REFERENCES

- A. FS W-C-596 – Electrical power connector, plug, receptacles and cable outlet.
- B. FS W-S-896 – Switch, toggle.
- C. NEMA WD 1 – General purpose wiring devices.
- D. NEMA WD 5 – Specific-purpose wiring devices.

1.3 SUBMITTALS

- A. Submit product data under Provisions of Contract and Division 1.
- B. Provide product data showing configurations, finishes, dimensions and manufacturer's instructions.

PART 2 – PRODUCTS

2.1 RECEPTACLES

- A. Convenience and straight-blade receptacles: 125 V, 2 pole, 3 wire, 20 ampere specification grade, ground fault interrupting or isolated ground type.
- B. Internal ground clip of receptacles shall be in one piece with the receptacle mounts.
- C. Receptacles with riveted ground clips will not be accepted.
- D. Isolated ground type receptacle shall be orange in color.

2.2 WALL SWITCHES

- A. Wall switches for lighting circuits and motor loads under ½ hp: AC general use snap switch with toggle handle, rated 20 amperes and 120-277 volts AC.
- B. Handle: Ivory plastic.

C. Pilot light type: Lighted handle. Pilot strap in adjacent gang.

D. Locator type: Lighted handle.

2.3 COVER PLATES

A. Decorative cover plate: Stainless steel 302/304 smooth Hubbell "S" series.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install receptacles on roof along parapet wall.

B. Install specific use receptacles at heights shown on contract drawings.

C. Drill opening for poke - through fitting installation in accordance with manufacturer's instructions.

D. Install plates on switch, receptacle, and blank outlets in finished areas, using jumbo size plates for outlets installed in masonry walls.

E. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings and on surface mounted outlets.

F. Install devices and wall plates flush and level.

END OF SECTION 260400

SECTION 260425

DIGITAL LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 SUMMARY

A. Section Includes

1. Digital Lighting Controls
2. Emergency Lighting Control (if applicable)

B. Related Sections

1. Section 26 04 00 Wiring Devices: Receptacles
2. Section 26 05 75 Interior Luminaires.
3. Electrical Sections, including wiring devices, apply to the work of this Section.

C. Control Intent – Control Intent includes, but is not limited to:

1. Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
2. Initial sensor and switching zones
3. Initial time switch settings
4. Emergency Lighting control (if applicable)

1.2 REFERENCES

- A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)
- B. Underwriter Laboratories of Canada (ULC)
- C. International Electrotechnical Commission (IEC)
- D. International Organization for Standardization (ISO)
- E. National Electrical Manufacturers Association (NEMA)
- F. WD1 (R2005) - General Color Requirements for Wiring Devices.
- G. Underwriters Laboratories, Inc. (UL)
 1. 508– Industrial Controls
 2. 924 – Emergency Lighting

1.3 SYSTEM DESCRIPTION & OPERATION

- A. The Lighting Control and Automation system as defined under this section covers the following equipment:
1. Digital Occupancy Sensors – Self-configuring, digitally addressable and calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
 2. Digital Switches – Self-configuring, digitally addressable pushbutton on/off, dimming, and scene switches with two-way active infrared (IR) communications.
 3. Digital Daylighting Sensors – Single-zone closed loop, multi-zone open loop and single-zone dual-loop daylighting sensors with two-way active infrared (IR) communications can provide switching, bi-level, tri-level or dimming control for daylight harvesting.
 4. Digital Room Controllers – Self-configuring, digitally addressable one, two or three relay plenum-rated controllers for on/off control. Selected models include 0-10 volt or line voltage forward phase control dimming outputs and integral current monitoring capabilities.
 5. Configuration Tools – Handheld remote for room configuration and relay panel programming provides two way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away. Unit to have Organic LED display, simple pushbutton interface, and allow bi-directional communication of room variables and occupancy sensor settings. Computer software also customizes room settings.
 6. Emergency Lighting Control Unit (ELCU) – allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building.

1.4 LIGHTING CONTROL APPLICATIONS

- A. Unless relevant provisions of the applicable local Energy Codes are more stringent, provide a minimum application of lighting controls as follows:
1. Space Control Requirements – Provide occupancy/vacancy sensors with Manual- or Partial-ON functionality in all spaces except toilet rooms, storerooms, library stacks, or other applications where hands-free operation is desirable and Automatic-ON occupancy sensors are more appropriate. Provide Manual-ON occupancy/vacancy sensors for any enclosed office, conference room, meeting room, open plan system and training room. For spaces with multiple occupants, or where line-of-sight may be obscured, provide ceiling- or corner-mounted sensors and Manual-ON switches.
 2. Daylit Areas – Provide daylight-responsive automatic control in all spaces (conditioned or unconditioned) where daylight contribution is available as defined by relevant local building energy code:
 - a. All luminaires within code-defined daylight zones shall be controlled separately from luminaires outside of daylit zones.
 - b. Daytime setpoints for total ambient illumination (combined daylight and electric light) levels that initiate dimming shall be programmed in compliance with relevant local building energy codes.
 - c. Multiple-leveled switched daylight harvesting controls may be utilized for areas marked on drawings.
 - d. Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system may be designed to turn off electric

lighting when daylight is at or above required lighting levels, only if system functions to turn lamps back on at dimmed level, rather than turning full-on prior to dimming.

3. Conference, meeting, training, auditoriums, and multipurpose rooms shall have controls that allow for independent control of each local control zone. Rooms larger than 300 square feet shall instead have at least four (4) pre-set lighting scenes unless otherwise specified. Occupancy / vacancy sensors shall be provided to extinguish all lighting in the space. Spaces with up to four moveable walls shall include controls that can be reconfigured when the room is partitioned.

1.5 SUBMITTALS

- A. Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.
- B. Shop Drawings
 1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.
 2. Show exact location of all digital devices, including at minimum sensors, room controllers, and switches for each area on reflected ceiling plans. (Contractor must provide AutoCAD format reflected ceiling plans.)
 3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.
 4. Network riser diagram including floor and building level details. Include network cable specification and end-of-line termination details, if required. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.
- C. Product Data: Catalog sheets, specifications and installation instructions.
- D. Include data for each device which:
 1. Indicates where sensor is proposed to be installed.
 2. Prove that the sensor is suitable for the proposed application.

1.6 QUALITY ASSURANCE

- A. Manufacturer: Minimum [10] years experience in manufacture of lighting controls.

1.7 PROJECT CONDITIONS

- A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
 1. Ambient temperature: 0° to 40° C (32° to 104° F).
 2. Relative humidity: Maximum 90 percent, non-condensing.

1.8 WARRANTY

- A. Provide a five year limited manufacturer's warranty on all room control devices and panels.

1.9 MAINTENANCE

A. Spare Parts

1. Provide spares of each product to be used for maintenance as listed below: Refer to design documents. Coordinate with owner for quantity prior to purchase order.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer

1. WattStopper
 - a. System: Digital Lighting Management (DLM)
2. Basis of design product: WattStopper Digital Lighting Management (DLM) or subject to compliance and prior approval with specified requirements of this section, one of the following:
 - a. Refer to design documents.

B. Substitutions: [If Permitted]

1. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional a minimum of 10 working days prior to the bid date and must be made available to all bidders. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.
2. By using pre-approved substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring. The contractor shall provide complete engineered shop drawings (including power and control wiring) with deviations from the original design highlighted for review and approval prior to rough-in.

2.2 DIGITAL LIGHTING CONTROLS

- A. Furnish the Company's system which accommodates the square-footage coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, switches, daylighting sensors and accessories which suit the lighting and electrical system parameters.

2.3 DIGITAL WALL SWITCH OCCUPANCY SENSORS

- A. Wallbox mounted passive infrared PIR or dual technology (passive infrared and ultrasonic) digital occupancy sensor with 1 or 2 switch buttons.
- B. Digital Occupancy Sensors shall provide scrolling LCD display for digital calibration and electronic documentation. Features include the following:
 1. Digital calibration and pushbutton configuration for the following variables:
 - a. Sensitivity – 0-100% in 10% increments
 - b. Time delay – 1-30 minutes in 1 minute increments
 - c. Test mode – Five second time delay

- d. Detection technology – PIR, Dual Technology activation and/or re-activation.
 - e. Walk-through mode
 - f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
- 2. Programmable control functionality including:
 - a. Each sensor may be programmed to control specific loads within a local network.
 - b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
 - c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically during the configurable period of time (default 10 seconds) after turning off.
- 3. Two RJ-45 ports for connection to DLM local network.
- 4. Two-way infrared (IR) transceiver to allow remote programming through handheld configuration tool and control by remote personal controls.
- 5. Device Status LEDs including:
 - a. PIR detection
 - b. Ultrasonic detection
 - c. Configuration mode
 - d. Load binding
- 6. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
- 7. Assignment of local buttons to specific loads within the room without wiring or special tools.
- 8. Manual override of controlled loads.
- 9. All digital parameter data programmed into an individual wall switch sensor shall be retained in non-volatile FLASH memory within the wall switch sensor itself. Memory shall have an expected life of no less than 10 years.
- D. Units shall not have any dip switches or potentiometers for field settings.
- E. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.
- F. Two-button wall switch occupancy sensors, when connected to a single relay dimming room controller, shall operate in the following sequence as a factory default:
 - 1. Left button
 - a. Press and release - Turn load on
 - b. Press and hold - Raise dimming load
 - 2. Right button
 - a. Press and release - Turn load off
 - b. Press and hold - Lower dimming load
- G. Low voltage momentary pushbuttons shall include the following features:

1. Load/Scene Status LED on each switch button with the following characteristics:
 - a. Bi-level LED
 - b. Dim locator level indicates power to switch
 - c. Bright status level indicates that load or scene is active
 2. The following button attributes may be changed or selected using a wireless configuration tool:
 - a. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
 - b. Individual button function may be configured to Toggle, On only or Off only.
 - c. Individual scenes may be locked to prevent unauthorized change.
 - d. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
 - e. Ramp rate may be adjusted for each dimmer switch.
 - f. Switch buttons may be bound to any load on a room controller and are not load type dependent; each button may be bound to multiple loads.
- H. WattStopper part numbers: LMPW, LMDW. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening.

2.4 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR

- A. Wall or ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor.
- B. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:
 1. Digital calibration and pushbutton configuration for the following variables:
 - a. Sensitivity – 0-100% in 10% increments
 - b. Time delay – 1-30 minutes in 1 minute increments
 - c. Test mode – Five second time delay
 - d. Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
 - e. Walk-through mode
 - f. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
 2. Programmable control functionality including:
 - a. Each sensor may be programmed to control specific loads within a local network.
 - b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
 - c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically within a configurable period of time (default 10 seconds) after turning off.
 - d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
 - i. Ultrasonic and Passive Infrared

- ii Ultrasonic or Passive Infrared
- iii Ultrasonic only
- iv Passive Infrared only

3. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
 4. One or two RJ-45 port(s) for connection to DLM local network.
 5. Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.
 6. Device Status LEDs, which may be disabled for selected applications, including:
 - a. PIR detection
 - b. Ultrasonic detection
 - c. Configuration mode
 - d. Load binding
 7. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
 8. Manual override of controlled loads.
 9. All digital parameter data programmed into an individual occupancy sensor shall be retained in non-volatile FLASH memory within the sensor itself. Memory shall have an expected life of no less than 10 years.
- C. Units shall not have any dip switches or potentiometers for field settings.
- D. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.
- E. WattStopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC

2.5 DIGITAL WALL SWITCHES

- A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration. Wall switches shall include the following features:
1. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
 2. Configuration LED on each switch that blinks to indicate data transmission.
 3. Load/Scene Status LED on each switch button with the following characteristics:
 - a. Bi-level LED
 - b. Dim locator level indicates power to switch
 - c. Bright status level indicates that load or scene is active
 4. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.

5. Programmable control functionality including:
 - a. Button priority may be configured to any BACnet priority level, from 1-16, corresponding to networked operation allowing local actions to utilize life safety priority
 - b. Scene patterns may be saved to any button other than dimming rockers. Once set, buttons may be digitally locked to prevent overwriting of the preset levels.
 6. All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years.
- B. Two RJ-45 ports for connection to DLM local network.
- C. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration shall be required to achieve multi-way switching.
- D. The following switch attributes may be changed or selected using a wireless configuration tool:
1. Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
 2. Individual button function may be configured to Toggle, On only or Off only.
 3. Individual scenes may be locked to prevent unauthorized change.
 4. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
 5. Ramp rate may be adjusted for each dimmer switch.
 6. Switch buttons may be bound to any load on a room controller and are not load type dependent; each button may be bound to multiple loads.
- E. WattStopper product numbers: LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-105, LMSW-108, LMDM-101. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening.

2.6 DIGITAL DAYLIGHTING SENSORS

- A. Digital daylighting sensors shall work with room controllers to provide automatic switching, bi-level, or tri-level or dimming daylight harvesting capabilities for any load type connected to a room controller. Daylighting sensors shall be interchangeable without the need for rewiring.
1. Closed loop sensors measure the ambient light in the space and control a single lighting zone.
 2. Open loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones.
 3. Dual loop sensors measure both ambient and incoming daylight in the space to insure that proper light levels are maintained as changes to reflective materials are made in a single zone.
- B. Digital daylighting sensors shall include the following features:

1. The sensor's internal photodiode shall only measure lightwaves within the visible spectrum. The photodiode's spectral response curve shall closely match the entire photopic curve. The photodiode shall not measure energy in either the ultraviolet or infrared spectrums. The photocell shall have a sensitivity of less than 5% for any wavelengths less than 400 nanometers or greater than 700 nanometers.
2. Sensor light level range shall be from 1-6,553 foot candles (fc).
3. The capability of ON/OFF, bi-level or tri-level switching, or dimming, for each controlled zone, depending on the selection of room controller(s) and load binding to room controller(s).
4. For switching daylight harvesting, the photosensor shall provide a field-selectable deadband, or a separation, between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling excessively after they turn off.
5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a field-selectable minimum level.
6. Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.
7. Photosensors shall provide adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut-off.
8. Optional wall switch override shall allow occupants to reduce lighting level to increase energy savings or, if permitted by system administrator, raise lighting levels for a selectable period of time or cycle of occupancy.
9. Integral infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
10. Configuration LED status light on device that blinks to indicate data transmission.
11. Status LED indicates test mode, override mode and load binding.
12. Recessed switch on device to turn controlled load(s) ON and OFF.
13. BACnet object information shall be available for the following daylighting sensor objects, based on the specific photocell's settings:
 - a. Light level
 - b. Day and night setpoints
 - c. Off time delay
 - d. On and off setpoints
 - e. Up to three zone setpoints
 - f. Operating mode – on/off, bi-level, tri-level or dimming
14. One RJ-45 port for connection to DLM local network.
15. A choice of accessories to accommodate multiple mounting methods and building materials. The photosensors may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox. Standard tube photosensors accommodate mounting materials from 0-0.62" thickness (LMLS-400, LMLS-500). Extended tube photosensors accommodate mounting materials from 0.62"-1.25" thickness (LMLS-400-L, LMLS-500-L). Mounting brackets are compatible with J boxes (LMLS-MB1) and wall mounting (LMLS-MB2). LMLS-600 photosensor to be mounted on included bracket below skylight well.
16. Any load or group of loads in the room can be assigned to a daylighting zone
17. Each load within a daylighting zone can be individually enabled or disabled for discrete control (load independence).
18. All digital parameter data programmed into a photosensor shall be retained in non-volatile FLASH memory within the photosensor itself. Memory shall have an expected life of no less than 10 years.

- C. Closed loop digital photosensors shall include the following additional features:
1. An internal photodiode that measures light in a 100-degree angle, cutting off the unwanted light from bright sources outside of this cone.
 2. Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software.
 3. Automatically establishes application-specific setpoints following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of loads.
 4. WattStopper Product Number: LMLS-400, LMLS-400-L.
- D. Open loop digital photosensors shall include the following additional features:
1. An internal photodiode that measures light in a 60-degree angle cutting off the unwanted light from the interior of the room.
 2. Automatically establishes application-specific setpoints following manual calibration using a wireless configuration tool or a PC with appropriate software. For switching operation, an adequate deadband between the ON and OFF setpoints for each zone shall prevent the lights from cycling; for dimming operation, a proportional control algorithm shall maintain the design lighting level in each zone.
 3. Each of the three discrete daylight zones can include any non overlapping group of loads in the room.
 4. WattStopper Product Number: LMLS-500, LMLS-500-L.
- E. Dual loop digital photosensors shall include the following additional features:
1. Close loop portion of dual loop device must have an internal photodiode that measures light in a 100 degree angle, cutting off the unwanted light from sources outside of this cone
 2. Open loop portion of dual loop device must have an internal photodiode that can measure light in a 60 degree angle, cutting off the unwanted light from the interior of the room.
 3. Automatically establishes application-specific set-points following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of load.
 4. Device must reference closed loop photosensor information as a base line reference. The device must be able to analyze the open loop photosensor information to determine if an adjustment in light levels is required.
 5. Device must be able to automatically commission setpoints each night to provide adjustments to electrical lighting based on changes in overall lighting in the space due to changes in reflectance within the space or changes to daylight contribution based on seasonal changes.
 6. Device must include extendable mounting arm to properly position sensor within a skylight well.
 7. WattStopper product number LMLS-600

2.7 DIGITAL ROOM CONTROLLERS

- A. Digital controllers for lighting automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room controllers shall be provided to match the room lighting and plug load control requirements. The controllers will be simple to install, and will not have dip switches or potentiometers, or require special configuration for standard Plug n' Go applications. The control units will include the following features:
1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
 2. Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf.
 3. Multiple room controllers connected together in a local network must automatically prioritize each room controller, without requiring any configuration or setup, so that loads are sequentially assigned using room controller device ID's from highest to lowest.
 4. Device Status LEDs to indicate:
 - a. Data transmission
 - b. Device has power
 - c. Status for each load
 - d. Configuration status
 5. Quick installation features including:
 - a. Standard junction box mounting
 - b. Quick low voltage connections using standard RJ-45 patch cable
 6. Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power:
 - a. Turn on to 100%
 - b. Remain off
 - c. Turn on to last level
 7. Each load shall be configurable to operate in the following sequences based on occupancy:
 - a. Auto-on/Auto-off (Follow on and off)
 - b. Manual-on/Auto-off (Follow off only)
 8. The polarity of each load output shall be reversible, via digital configuration, so that on is off and off is on.
 9. UL 2043 plenum rated
 10. Manual override and LED indication for each load
 11. Dual voltage (120/277 VAC, 60 Hz), or 347 VAC, 60 Hz (selected models only). 120/277 volt models rated for 20A total load, derating to 16A required for some dimmed loads (forward phase dimming); 347 volt models rated for 15A total load; plug load controllers carry application-specific UL 20 rating for receptacle control.

12. Zero cross circuitry for each load
 13. All digital parameter data programmed into an individual room controller or plug load controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.
- B. On/Off Room Controllers shall include:
1. One or two relay configuration
 2. Efficient 150 mA switching power supply
 3. Three RJ-45 DLM local network ports with integral strain relief and dust cover
 4. WattStopper product numbers: LMRC-101, LMRC-102
- C. On/Off/Dimming enhanced Room Controllers shall include:
1. Real time current monitoring
 2. Multiple relay configurations
 - a. One, two or three relays (LMRC-21x series)
 - b. One or two relays (LMRC-22x series)
 3. Efficient 250 mA switching power supply
 4. Four RJ-45 DLM local network ports with integral strain relief and dust cover
 5. One dimming output per relay
 - a. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting. (LMRC-21x series)
 - b. Line Voltage, Forward Phase Dimming - Where indicated, one forward phase control line voltage dimming output per relay for control of compatible two-wire or three-wire ballasts, LED drivers, MLV, forward phase compatible ELV, neon/cold cathode and incandescent loads. (LMRC-22x series)
 - c. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected ballast or driver.
 - d. The LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim.
 - e. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100% dimming range defined by the minimum and maximum calibration trim.
 - f. Calibration and trim levels must be set per output channel.
 - g. Devices that set calibration or trim levels per controller are not acceptable.
 - h. All configuration shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.

6. Each load shall have an independently configurable preset on level for Normal Hours and After Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After Hours events.
 7. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.
 8. The following dimming attributes may be changed or selected using a wireless configuration tool:
 - a. Establish preset level for each load from 0-100%
 - b. Set high and low trim for each load
 - c. Set lamp burn in time for each load up to 100 hours
 9. Override button for each load provides the following functions:
 - a. Press and release for on/off control
 - b. Press and hold for dimming control
 10. WattStopper product numbers: LMRC-211, LRMC-212, LRMC-213, LMRC-221, LMRC-222
- EMERGENCY LIGHTING CONTROL DEVICES**
- A. Emergency Lighting Control Unit – A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:
 1. 120/277 volts, 50/60 Hz, 20 amp ballast rating
 2. Push to test button
 3. Auxiliary contact for remote test or fire alarm system interface
 - B. WattStopper Product Numbers: ELCU-100, ELCU-200.

PART 3 – EXECUTION

3.1 OPTIONAL PRE-INSTALLATION MEETING

- A. A factory authorized manufacturer's representative shall provide the electrical contractor a functional overview of the lighting control system prior to installation. The contractor shall schedule the pre-installation site visit after receipt of approved submittals to review the following:
 1. Confirm the location and mounting of all digital devices, with special attention to placement of occupancy and daylighting sensors.
 2. Review the specifications for low voltage control wiring and termination.
 3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.
 4. Discuss requirements for integration with other trades.

3.2 CONTRACTOR INSTALLATION AND SERVICES

- A. Contractor to install all devices and wiring in a professional manner. All line voltage connections to be tagged to indicate circuit and switched legs.

- B. Contractor to install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors. If pre-terminated cable is not used for room/area wiring, the contractor is responsible for testing each field-terminated cable following installation and shall supply the lighting controls manufacturers with test results. Contractor to install any room to room network devices using manufacturer-supplied LM-MSTP network wire. Network wire substitution is not permitted and may result in loss of product warranty per DLM SEGMENT NETWORK section of specification. Low voltage wiring topology must comply with manufacturer's specifications. Contractor shall route network wiring as shown in submittal drawings as closely as possible, and shall document final wiring location, routing and topology on as built drawings.
- C. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated. Before start up, contractor shall test all devices to ensure proper communication.
- D. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lighted while occupied.
- E. Provide written or computer-generated documentation on the configuration of the system including room by room description including:
 - 1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
 - 2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
 - 3. Load Parameters (e.g. blink warning, etc.)
- F. Post start-up tuning – After 30 days from occupancy contractor shall adjust sensor time delays and sensitivities to meet the Owner's requirements. Provide a detailed report to the Architect / Owner of post start-up activity.

3.3 FACTORY SERVICES

- A. Upon completion of the installation, the manufacturer's factory authorized representative shall start up and verify a complete fully functional system.
- B. The Electrical Contractor shall provide both the manufacturer and the electrical engineer with three weeks written notice of the system start up and adjustment date.
- C. Upon completion of the system start up, the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.

3.4 COMMISSIONING SUPPORT SERVICES

- A. On this project, a commissioning agent will be hired to verify the installation and programming of all building systems, which includes the lighting control system. Manufacturer should include an extra day of technician's time to review the functionality and settings of the lighting control hardware with the commissioning agent, including reviewing submittal drawings and ensuring that instructions on how to configure each device are readily available. Manufacturer is NOT responsible for helping the commissioning agent inspect the individual devices. It will be the commissioning agent's responsibility to create and complete any forms required for the commissioning process, although the manufacturer or contractor may offer spreadsheets and/or printouts to assist the agent with this task.

- B. The commissioning agent shall work with the Electrical Contractor during installation of the lighting control hardware to become familiar with the specific products. The agent may also accompany the manufacturer's technicians during their start-up work to better understand the process of testing, calibration and configuration of the products. However, the contractor and manufacturer shall ensure that interfacing with the agent does not prevent them from completing the requirements outlined in the contract documents.

3.5 ACCEPTANCE TESTING SUPPORT SERVICES

- A. On all California projects, a certified lighting controls acceptance test technician (CLCATT) must verify the installation of the lighting control system. Manufacturer should include an extra day of factory technician's time to assist the CLCATT review the functionality and settings of the lighting control hardware per the requirements in the California State forms. It will be the CLCATT's responsibility to create and complete any forms required for the commissioning process, although the manufacturer or contractor may offer spreadsheets and/or printouts to assist the CLCATT with this task.

END OF SECTION 260425

SECTION 260450
CABINETS AND ENCLOSURES

PART 1 - GENERAL

Applicable Provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

- A. The work under this section shall include the furnishing of all materials, labor, tools and services necessary to install hinged cover enclosures to complete all work shown on the Drawings or specified herein.

1.2 REFERENCES

- A. NEMA 250 - Enclosures for electrical equipment (1000 volts maximum).
- B. Submittals - Submit product data under Provisions of Contract and Division 1.

PART 2 - PRODUCTS

2.1 HINGED COVER ENCLOSURES

- A. Construction: NEMA 250; Type 1 and 3R steel.
- B. Finished: Manufacturer's standard enamel finish.
- C. Covers: Continuous hinge, held closed by operable by key.
- D. Provide barriers between normal and emergency wiring. Barriers shall be of non-current carrying material of adequate thickness for mechanical strength but in no case less than 1/4". Each barrier shall have an angle iron framing support all around.

2.2 FABRICATION

- A. Shop assemble enclosures in accordance with ANSI/NEMA ISC 6.
- B. Provide knockouts on enclosures.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install enclosures plumb; Anchor securely to wall and structural supports at each corner, minimum.
- B. Provide necessary feet for free-standing equipment enclosures.
- C. Install trim plumb.

END OF SECTION 260450

SECTION 260500

SUPPORTING DEVICES

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

- A. The work under this section shall include the furnishing of all material, labor, tools and services necessary to install rigid metal conduit, electrical metallic tubing and flexible metal conduit, including all fittings to complete all work shown on the Drawings or specified herein.

1.2 RELATED WORK

- A. Conduit and equipment supports.
- B. Fastening hardware.

1.3 REFERENCES

- A. Conduit supports.

1.4 QUALITY ASSURANCE

- A. Support system shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Support channel: Galvanized or painted steel.
- B. Hardware: Corrosion resistant.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fasteners in Pre-Cast Concrete: Fastener system of type for suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other necessary devices for attaching hangers of type required and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing in accordance to ASTM E1190 conducted by a qualified independent agency. Anchors shall not be installed where reinforcing strands are located in plank. Review pre-cast plank shop drawings to determine location.

- B. Refer to pre-cast concrete plank shop drawings for location of strand reinforcing and cores. Do not anchor where reinforcing is located. Use fasteners in concrete, toggle bolts or thru-core anchors with plates supported on top of plank in cores.
- C. Fasten hanger rods, conduit clamps, outlet, junction boxes to building structure using preset inserts, beam clamps and spring steel clips.
- D. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; Expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs and wood screws in wood construction.
- E. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.
- F. Do not use powder-actuated anchors.
- G. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- H. In wet locations install free-standing electrical equipment on concrete pads.
- I. Install surface mounted cabinets and panelboards with minimum of four anchors. Provide steel channel supports to stand cabinet one inch off wall.
- J. Bridge studs top and bottom with channels to support flush mounted cabinets and panelboards in stud walls.

END OF SECTION 260500

SECTION 260550

GENERAL LABELING AND IDENTIFICATION

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

- A. The work under this section shall include the furnishing of all material, labor, tools and services necessary to install nameplates, tape labels, wire markers, conduit color coding to complete all work shown on the Drawings or specified herein.

1.2 RELATED WORK

- A. Painting.

1.3 SUBMITTALS

- A. Submit shop drawings under provisions of Division 1.
- B. Include schedule for nameplates and tape labels.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Nameplates: Engraved three-layer laminated plastic, white letters on a black background.
- B. Tape labels: Embossed adhesive tape with 3/16 inch black letters on a white background.
- C. Wire and cable markers: Cloth markers, split sleeve or tubing type.

PART 3 - EXECUTION

3.1 INSTALLATION

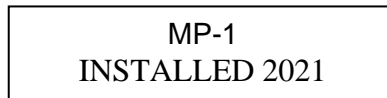
- A. De-grease and clean surfaces to receive nameplates and tape labels.
- B. Install nameplates and tape labels parallel to equipment lines.
- C. Secure nameplates to equipment fronts using screws, rivets, or adhesive. Secure nameplate to inside face of recessed panelboard doors in finished locations.
- D. Embossed tape will not be permitted for any application. Use embossed tape only for identification of individual wall switches and receptacles and control device stations.

3.2 WIRE IDENTIFICATION

- A. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes and at load connection. Identify each branch circuit or feeder number for power and lighting circuits and each control wire number as indicated on equipment manufacturer's shop drawings for control wiring.

3.3 NAMEPLATE ENGRAVING SCHEDULE

- A. Provide nameplates to identify all electrical distribution, control equipment and loads served including year of installation. Letter height: 1/2 inch for individual switches, loads served, distributions and control equipment identification. For example:



- B. Panelboards: 3/4 inch, identify equipment designation. 1/2 inch, identify voltage rating and source of power.
- C. Individual circuit breakers, switches and motor starters in panelboards, switchboards and motor control centers: 1/4 inch, identify circuit and load served, including location.
- D. Individual circuit breakers, enclosed switches and motor starters: 1/2 inch, identify load served.

3.4 FIRE ALARM

- A. All fire alarm raceway components shall be painted red and identified.

END OF SECTION 260550

SECTION 260575
INTERIOR LUMINAIRES

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

- A. Interior luminaires and accessories.
- B. Emergency lighting units.
- C. Exit signs.
- D. LED Driver.
- E. LED dimming and controls.
- F. LED emergency power supply.
- G. Lamps.
- H. Luminaire accessories.

1.2 REFERENCES

- A. ANSI/IES RP-16-10 – Nomenclature and Definitions for Illuminating Engineering.
- B. ANSI C78.37 7 – Specifications for the Chromaticity of Solid-State Lighting (SSL) Products.
- C. IES LM-79-08 – Electric and Photometric Measurements of Solid-State Lighting Products.
- D. IES LM-80-08 – Measuring Lumen Maintenance of LED Light Sources.
- E. IES 7M-21-11 – Projecting Long Term Lumen Maintenance of LED Light Sources.
- F. IES LM-82-11 – IES Approved Method for the Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature.
- G. UL 8750 – LED Equipment for Use in Lighting Products.
- H. NEMA WD 6 - Wiring Devices – Dimensional Requirements.
- I. NFPA 70 - National Electrical Code.
- J. NFPA 101- Life Safety Code.

1.3 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five (5) years documented experience.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70 and to requirements of NFPA 101.
- B. Products: Listed and classified by Underwriters Laboratories, Inc. (UL), American National Standards Institute (ANSI) and Illuminating Engineering Society (IES).

1.5 SUBSTITUTIONS

- A. All proposed substitutions must be submitted with each light fixture specification cutsheet, accompanied with foot-candle calculation for all spaces, provided for Architect and Engineer's review, prior to approval.
- B. If the substitution is accepted, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring.

PART 2 - PRODUCTS

2.1 LUMINAIRES

- A. Furnish Products as scheduled.

2.2 EXIT SIGNS

- A. Manufacturers: As scheduled.
- B. Description: Exit sign fixture suitable for use as emergency lighting unit.
- C. Housing: Extruded aluminum or steel as per schedule.
- D. Face: Aluminum stencil face with red letters, unless otherwise noted.
- E. Directional Arrows: Universal type for field adjustment, direction per drawing.
- F. Mounting: Universal, for field selection or per drawing.
- G. Lamps: L.E.D.
- H. Input Voltage: As scheduled.

2.3 LED DRIVERS

- A. Manufacturers: As scheduled.
- B. Voltage: As scheduled.

2.4 LAMPS

- A. Lamp Types: As specified for luminaire. LED source.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
- B. Support luminaires 2 x 4 foot (600 x 1200 mm) and larger in size independent of ceiling framing.
- C. All lay-in luminaires shall be supported with chains to building structure.
- D. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- E. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure. Provide auxiliary members spanning ceiling grid members to support surface mounted luminaires. Fasten surface mounted luminaires to ceiling grid members using bolts, screws, rivets, or suitable clips.
- F. Install wall mounted luminaires, emergency lighting units and exit signs at 80" above finished floor, unless otherwise noted.
- G. Install accessories furnished with each luminaire.
- H. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- I. Bond products and metal accessories to branch circuit equipment grounding conductor.
- J. Install specified lamps in each emergency lighting unit, exit sign, and luminaire.

3.2 FIELD QUALITY CONTROL

- A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.3 ADJUSTING

- A. Aim and adjust luminaires as indicated.
- B. Position exit sign directional arrows as indicated.

3.4 CLEANING

- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Remove dirt and debris from enclosures.

- C. Clean photometric control surfaces as recommended by manufacturer.
- D. Clean finished and touch up damage.

3.5 PROTECTION OF FINISHED WORK

- A. Relamp luminaires that have failed lamps as substantial completion.

END OF SECTION 260575

SECTION 260600

DISCONNECT SWITCHES

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

- A. The work under this section shall include the furnishing of all materials, labor, tools and services necessary to install disconnect switches, fuses and enclosures to complete all work shown on the Drawings or specified herein.

1.2 SUBMITTALS

- A. Submit product data under Provisions of Contract and Division 1.
- B. Include outline Drawings with dimensions, equipment ratings for voltage, capacity, horsepower and short circuit.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - DISCONNECT SWITCHES

- A. Siemens.
- B. Square 'D'.
- C. General Electric.
- D. Or approved equal.

2.2 DISCONNECT SWITCHES

- A. Fusible switch assemblies: Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch is in ON position. Handle lockable in OFF position. Fuse clips: Designed to accommodate class R, J fuses.
- B. Non-fusible switch assemblies: Quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- C. Enclosures: NEMA Type 1; 3R; 4 as indicated on Drawings.

2.3 ACCEPTABLE MANUFACTURERS - FUSES

- A. Bussman.

- B. Ferraz-Shawmut.
- C. Or approved equal.

2.4 FUSES

- A. Fuses 600 amperes and less: ANSI/UL 198E, class RK1; RK5; Dual element, current limiting, time delay, 250 volt.
- B. Interrupting rating: 200,000 rms amperes.
- C. An additional fuse of each size required to be supplied.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install disconnect switches where indicated on Drawings.
- B. Install fuses in fusible disconnect switches.
- C. Disconnects installed outdoors shall have NEMA 3R enclosures.
- D. Disconnects installed indoors in dry locations shall have NEMA 1 enclosure.

END OF SECTION 260600

SECTION 260650

GROUNDING

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

- A. The work under this section shall include the furnishing of all materials, labor, tools and services necessary to install the power system grounding to complete all work shown on the Drawings or specified herein.

1.2 RELATED WORK

- A. Panelboards.
- B. Raceways.
- C. Connection Equipment.
- D. Electric Equipment.
- E. Tests and Acceptance.
- F. Transformers.
- G. Electric Service.

1.3 SUBMITTALS

- A. Manufacturers' data, catalog cuts of ground rods, connectors, bushings, etc., along with recommended installation procedures.

PART 2 - PRODUCTS

2.1 WIRING

- A. All wiring used for grounding shall be insulated copper, unless otherwise noted. Size shall be in accordance with code for the application, minimum #12.
- B. Where used in conjunction with computer equipment, grounding conductors shall be equal in size to the phase conductors.
- C. Avoid splices in ground conductors.

2.2 RACEWAY

- A. Grounding continuity shall be maintained for all metallic raceways.
- B. Provide bonding jumpers across metal parts separated by non-conducting materials.
- C. Where a grounding conductor is installed as a supplement to metallic raceway serving as the equipment grounding conductor, bonding conductor to the raceway at each end.
- D. All raceway accessories, such as locknuts, bushings, expansion fittings, etc. shall be installed to provide maximum metal-to-metal bonding.

2.3 CLAMPS

- A. Provide approved ground clamps for connecting grounding conductors to pipe, conduits, wireways, building steel, grounding rods, etc.
- B. Where bond will be in an inaccessible location or as an alternate to ground clamps, provide exothermic weld, similar to Cadweld.

2.4 ACCESSORIES

- A. Provide all necessary accessories of appropriate size and material for connection or termination of grounding conductors including:
 - 1. Straps.
 - 2. Clamps.
 - 3. Lugs.
 - 4. Bars and buses.
 - 5. Isolators (where applicable).
 - 6. Locknuts and bushings.

2.5 ACCEPTABLE MANUFACTURERS

- A. Copperweld.
- B. Cadweld (for exothermic welds).
- C. O.Z. Gedney.
- D. Burndy.

PART 3 - EXECUTION

3.1 SERVICE ENTRANCE/SWITCH

- A. Coordinate all bonding and grounding requirements of the service entrance with the utility company.
- B. Provide ground lug in each switchboard, minimum 25% of phase bus, along entire length of switchboard.
- C. Separately connect each ground to existing grounding electrode. Test existing grounding electrode for proper resistance values and provide all necessary modifications required.

3.2 TRANSFORMERS

- A. Bond each transformer secondary neutral to nearest building structural column or beam via transformer case grounding stud.
- B. Provide jumper between transformer case and all conduit bushings.
- C. Where a separate equipment-grounding conductor is provided the primary and/or secondary feeders; bond to transformer grounding stud.
- D. Where isolation shield is provided, bond to transformer grounding stud.
- E. Where a separate ground riser is provided in addition to or instead of building steel; bond transformer-grounding stud to the ground riser.

3.3 STRUCTURAL STEEL BUILDINGS

- A. Select a column common to aligned electric closets as the bonding column for grounding of transformer neutrals, isolated grounds and separate equipment grounding conductors.
- B. All grounding conductors in each closet shall be bonded in close proximity to one another.
- C. Where a grounding conductor to be bonded is not in proximity to the common column, bond to the nearest column or structural beam.
- D. Provide bonding jumper strap across all structural expansion joints where the grounding integrity of the structural system is reduced

3.4 RACEWAYS

- A. Grounding continuity is to be maintained for all metallic raceways. Provide necessary clamps, bushings, straps and locknuts to assure continuity.
- B. For non-metallic or flexible raceways, provide a separate equipment-grounding conductor bonded to both ends.
- C. Where indicated, an additional equipment-grounding conductor shall be provided in metallic raceway.
- D. Where indicated, an isolated ground conductor shall be provided in addition to the equipment-grounding conductor. Bond at each end to the isolated ground terminal identified.

3.5 EQUIPMENT

- A. All equipment shall be grounded.
- B. Where isolated grounding is indicated, it shall be for the isolation of internal equipment components only. All metallic enclosures of such equipment shall be connected to the equipment ground system.

3.6 PANELBOARDS

- A. All panelboards and distribution panels shall be provided with a ground bar bonded to the enclosure. Provide an isolated ground bar connected to the incoming feeder ground where indicated.

3.7 TESTING

- A. Upon completion of the installation, confirm the grounding continuity of all raceways, conductors and equipment. Maximum allowable resistance is 25 ohms.

3.8 RECORD DRAWINGS

- A. Submit record As-Built Drawings indicating the location of all points where grounding conductors are bonded to steel, rods, plates, etc.
- B. Indicate the location of all grounding buses not installed within distribution equipment.

END OF SECTION 260650

SECTION 260675

HIGH PERFORMANCE K-7 DRY TYPE TRANSFORMERS

PART 1 - GENERAL

Applicable provisions of the conditions of the Contract and Division 1 General Requirements govern the work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

- A. Fabricate and test low voltage dry-type distribution transformers as described in this specification and on the Drawings.

1.2 SUMMARY

- A. Transformers on this project significantly exceed basic DOE 2016 requirements being optimized to provide 33% energy savings on average compared to a comparable DOE 2016 transformer when feeding predominately electronic equipment in the 0-25% loading range.
- B. General Purpose Transformers do NOT meet this specification as they do not carry a UL Listing for this application.
- C. Other highlights of requirements of this specification include:
 - 1. Copper wound.
 - 2. K-7 rated.
 - 3. No load loss limits.
 - 4. Efficiency under nonlinear loading to ensure real world performance.
 - 5. 105% continuous duty overload capacity
 - 6. Performance Validation Reports for each unit shipped on project signed by a professional engineer.
 - 7. Lockable Hinged Door to reduce arc flash risk when accessing for maintenance & thermal scans.
- D. Information to be submitted with bid:
 - 1. Line-by-line compliance, deviation, exception for this specification
 - 2. Performance Guarantee by Manufacturer that ALL transformers on this project will meet specified performance.
 - 3. Failure to provide this information will result in a non-compliant proposal.

1.3 REFERENCES

- A. US Department of Energy, 10 CFR Part 431 – Energy Efficiency Program for Certain Commercial and Industrial Equipment, Subpart K – Distribution Transformers.
- B. US Department of Energy, 10 CFR Part 429 – Certification, Compliance, and Enforcement for Consumer Products and Commercial and Industrial Equipment.

- C. ANSI/NEMA ST 20 - 2014 - Dry Type Transformers for General Applications.
 - D. Metering Standards:
 - 1. Computational algorithms per IEEE Std 1459-2000
 - 2. UL 916, UL 61010C-1 CAT III
 - E. IEEE C57.110-2008 – IEEE Recommended Practice for establishing liquid-filled and dry-type power distribution transformer capability when feeding non-sinusoidal load currents
 - F. IEEE Std C57.12.91-1995 Standard Test Code for Dry-Type Transformers
 - G. IEEE-1100 – Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
 - H. LEED – Leadership in Energy and Environmental Design, U.S. Green Building Council.
 - I. Seismic Qualification References: International Building Code, 2006/2009 Edition, California Building Code, 2007/2010 Edition, ASCE Standard 7, 2005 Edition to OSHPD CAN 2-1708A.5, Rev. , ICC-ES AC 156, Effective 01/01/2007, OSHPD
 - J. ISO 9001:2008 – International Standards Organization - Quality Management System
 - K. ISO 14001:2004 – International Standards Organization - Environmental Management System
 - L. ISO 17025 – International Standards Organization - General requirements for the competence of testing and calibration laboratories
- 1.4 BID PROPOSAL
- A. Compliance Review
 - 1. Submit a complete copy of these specifications with each subparagraph marked either "compliance", "deviation", or "exception". Fully describe all deviations and exceptions taken to this specification.
 - a. "Compliance": Comply with no exceptions.
 - b. "Deviation": Comply with deviations. For each and every deviation, provide a numbered footnote with reasons for the proposed deviation and how the intent of the Specification can be satisfied.
 - c. "Exception": Exception, do not comply. For each and every exception, provide a numbered footnote with reasons and possible alternatives.
 - 2. Unless a deviation or exception is specifically noted in the Compliance Review, it is assumed that the Bidder is in complete compliance with this Specification. Deviations or exceptions taken in cover letters, subsidiary documents, by omission or by contradiction do not release the Bidder from being in complete compliance, unless the exception or deviation has been specifically noted in the Compliance Review. Bidders may submit the latest state-of-the-art components and their standard control components in lieu of the specified items. All deviations from the Specifications must be approved by the Architect/Engineer.
 - 3. Failure to provide this information will result in a non-compliant proposal.

1.5 SUBMITTALS - Submit product data including the following:

- A. Manufacturer documentation guaranteeing that ALL units on the project will comply with the performance requirements of this specification.
- B. Where one or more of the integrated transformer options is selected for this project, provide associated documentation.
- C. Insulation system impregnant data sheet as published by supplier.
- D. Construction details including enclosure dimensions, kVA rating, primary & secondary nominal voltages, voltage taps, BIL, unit weight.
- E. Basic Performance characteristics including insulation class, temperature rise, core and coil materials, impedances & audible noise level, unit weight.
- F. Manufacturer documentation that sizing primary protection at 125% of nominal full load amps will not result in nuisance tripping on transformer inrush.
- G. Documentation of UL listing of 2" clearance from ventilated surface.
- H. Inrush Current (typical 3 cycle recovery).
- I. Short Circuit Current data: Primary & Secondary.
- J. Efficiency, Loss & Heat output Data.
- K. No load and full load losses per NEMA ST20.
- L. Linear load data @ 1/6 load.
- M. Linear load data @ 1/4, 1/2, 3/4 & full load.
- N. Linear Load efficiency @ 35% loading tested per NEMA TP-2.
- O. Efficiency under K7 load profile at 16.7%, 25%, 50%, 75%, 100% of nameplate rating.
- P. Factory ISO 9001 procedure describing nonlinear load test program.
 - 1. Meter and CT details including model, accuracy, serial numbers and calibration information.
- Q. 32 year Product and Performance Warranty Certificate.
- R. Manufacturer's ISO 14001:2004 Certification.
- S. Manufacturer's ISO 9001:2008 Certification.
- T. ISO 17025 Certificate - Efficiency Test Lab where transformers are tested.
- U. Documentation that materials used for shipment packaging meet the environmental requirements of this specification.
- V. For LEED projects, provide the following additional submittal information:
 - 1. Optimize Energy Performance: Provide savings calculations vs. DOE 2016 baseline reference.

1.6 CLOSEOUT SUBMITTALS

- A. Comprehensive Operations and Maintenance Manual.
- B. Applicable wiring diagrams, including any modifications made.
- C. Copies of completed factory and site testing reports.

1.7 NONLINEAR LOAD TEST PROGRAM

- A. Efficiency shall be determined by actual measurements using a nonlinear load bank. Calculations based on software modeling is not acceptable.
- B. Nonlinear Load Testing shall be carried out by an ISO 17025 Certified Efficiency Test Lab, and follow a defined protocol, independently audited within the manufacturer's certified ISO system.
- C. Follow IEEE Std C57.12.91-1995 Standard Test Code for Dry-Type Transformers to determine efficiency. Proprietary or non-standard methodology is not acceptable.
- D. The nonlinear load bank shall consist of phase-neutral loads, representative of a mix of electronic equipment.
- E. Meters and CTs shall both be revenue class accurate and carry current calibration certificates. CTs shall be operated within their approved accuracy loading range. Dual meters shall gather simultaneous primary and secondary energy and harmonic data. Meter and CT details including model, accuracy, serial numbers and calibration information.
- F. Efficiency: Measurements shall be taken at multiple load levels and plotted to show compliance with specification and correlation to the designed efficiency curve.
- G. Harmonic data including current and Voltage THD at the different load levels shall be included with the test report.

1.8 PACKAGING FOR SHIPMENT

- A. Transformers shall be packaged for shipment using materials that reduce environmental impact:
 - 1. Transformer Wrapping
 - a. Transformers shall be wrapped for shipment in material that is recyclable or compostable at the destination
 - 2. Transformer Shipping Base
 - a. Transformers shall be shipped on a base that uses at least 50% less wood than traditional pallets.
 - b. Wood used in the shipping base shall be Forestry Stewardship Council (FSC) certified as having been sustainably harvested.
 - 3. Shall minimize labor, risk of injury and equipment damage, while handling from initial transportation through to final placement of the transformer.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Store and protect products.
- B. Store in a warm, dry location with uniform temperature. Cover ventilation openings to keep out dust, water and other foreign material.
- C. Handle transformers using lifting eyes and/or brackets provided for that purpose. Protect against unfavorable external environment such as rain and snow, during handling.

1.10 WARRANTY

- A. Transformer shall carry a 32-year pro-rated warranty, which shall be standard for the product line.
- B. Guaranteed Performance: Manufacturer warranty shall explicitly state that every transformer is guaranteed to meet published performance data.
- C. Manufacturer warranty shall remain in effect through a qualified seismic event.

1.11 COMMERCIAL PRODUCT

- A. Transformer shall be a standard item in the manufacturer's catalog.

1.12 FACTORY WITNESS TESTING

- A. At time of order, the customer may request that the project engineer or other designated customer representative witness the performance testing of one or more of the transformers on the project at the manufacturer's facility, along with a demonstration of integrated metering option if specified.

1.13 PERFORMANCE VALIDATION REPORTS

- A. A Performance Validation Report shall be provided for EACH transformer shipped on this project as follows:
 - 1. Documentation shall be certified and signed by a (factory) professional engineer (PE), and identify each product by model and serial number.
 - 2. Transformers shall be tested in an ISO 17025 Certified Test Lab.
 - 3. Validation Report shall contain two components:
 - a. Test Report per DOE Test Method for Measuring the Energy Consumption of Distribution Transformers under Appendix A to Subpart K of 10 CFR part 431, identifying no load losses, and efficiency at 35% loading.
 - b. Routine Test Report per NEMA ST20 including audible noise test for each unit.

1.14 INTERNATIONAL STANDARDS ORGANIZATION REGISTRATION

- A. Registration of the manufacturer to current versions of the following ISO standards is required.
 - 1. ISO 9001:2008 – Quality Management System
 - 2. ISO 14001:2004 – Environmental Management System

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS/PRODUCT

- A. Basis of Design: E-Saver-33L by Powersmiths International Corp. (contact Andy Topinka – andy@tgs-inc.com 862-210-8126).
- B. Manufacturers wishing to have products evaluated for acceptability and conformance with the performance requirements of this specification, shall provide detailed compliance and/or exception statements, along with the documentation required in the submittal section, including test documentation, signed by an engineer, that confirms that the transformer(s) meets the specified performance.
- C. Failure to provide the required documentation no less than 7 days prior to the bid date will disqualify products from consideration for this project.

2.2 TRANSFORMER SPECIFICATION

- A. Compatibility: This product must facilitate the ability of the electrical system to supply a sinusoidal voltage in order to improve the long-term compatibility of the electrical system with both linear and nonlinear loads.
- B. 3-phase, common core, ventilated, dry-type, isolation transformer built to UL1561, NEMA ST20 and other relevant NEMA, UL and IEEE standards; 200% rated neutral; 60Hz rated; Transformers shall be UL or cUL Listed, and/or CSA Approved. All terminals, including those for changing taps, must be readily accessible by removing a front cover plate. Windings shall be continuous with terminations brazed or welded. 10kV BIL.
- C. Lugs are not provided by the transformer manufacturer.
- D. Winding Material: Copper
- E. K-Rating: K-7 (per IEEE-C57.110)
- F. Impedance: 4.0% or greater (unless otherwise noted) in order to manage downstream fault and arc flash levels, and required downstream component fault interrupting (kAIC) ratings.
- G. Inrush: Inrush currents are managed in order to avoid nuisance tripping of the primary breaker and to enable the use of standard 125% rated primary protection, thereby avoiding expensive design changes that otherwise may be needed.

- H. Operating Temperature Rise: 130 degree C in a 40 degree C maximum ambient.
- I. Continuous Duty Overload Capacity: 105% of nominal kVA Rating.
- J. Voltage Taps: For transformers 15kVA-750kVA, provide two 2-1/2% full capacity taps above and four 2-1/2% taps below nominal primary voltage.
- K. Audible Noise levels:
 - 1. Every unit to meet required noise level. Production Test every unit. Data to be available upon request.
 - 2. Must meet 3 dB quieter than NEMA ST-20 as follows:
 - a. Up to 50kVA: 42dB, 51-150kVA: 47dB, 151-300kVA: 52dB, 301-500kVA: 57dB, 501-700kVA: 59dB, 701-1000kVA: 61dB
- J. Enclosure type: Ventilated NEMA 1 enclosure with Lockable Hinged Doors
 - 1. Provide lockable hinged doors on the transformer to facilitate access in support of NFPA 70E/CSA-Z462 Arc Flash Standard to minimize arc flash risk when opening the enclosure of live equipment.
- K. Rear Clearance: UL Listed for 2" clearance from the wall rather than standard 6". This capability shall be explicitly described on the nameplate of each unit.
- L. Exceed minimum efficiency requirements of US Department of Energy, 10 CFR Part 431 (DOE 2016), by complying with the table of Maximum No Load Losses, efficiency requirements at 1/6 load, efficiency at 35% load, and efficiency at 25% load under a K-7 load profile. Testing backed by ISO 17025 efficiency test lab.

kVA	Max. No load losses (Watts)	Efficiency @ 1/6 load (%)	Efficiency @ 35% load (%)	Efficiency at 25% load under K-7 nonlinear load
15	34	98.17	98.24	98.18
20	42	98.27	98.34	98.28
25	50	98.37	98.44	98.38
30	57	98.47	98.54	98.48
45	80	98.61	98.71	98.62
50	86	98.64	98.73	98.65
63	101	98.71	98.79	98.72
75	114	98.78	98.84	98.78
100	145	98.85	98.93	98.85
112.5	160	98.88	98.97	98.88
125	175	98.90	98.99	98.88
150	204	98.93	99.03	98.88
175	229	98.96	99.06	98.95
200	255	99.00	99.10	99.01


225	281	99.03	99.13	99.08
250	304	99.05	99.15	99.08
300	352	99.09	99.20	99.08
400	431	99.15	99.24	99.13
450	471	99.17	99.26	99.16
500	511	99.20	99.28	99.18
600	597	99.22	99.30	99.22
750	726	99.24	99.33	99.28

M. Maximum Allowable Footprint:

kVA	Standard Case Size (in)	Alternate Smaller Case Size (in)*
15	17.5W x 17D x 27.5H	17.5W x 14.5D x 25H
20	25.5W x 18D x 30H	23W x 15.5D x 27.5H
25	25.5W x 18D x 30H	23W x 15.5D x 27.5H
30	25.5W x 18D x 30H	23W x 15.5D x 27.5H
45	25.5W x 18D x 30H	25.5W x 16D x 29H
50	25.5W x 18D x 30H	No Alternate
63	31.5W x 21.5D x 40H	26.5H x 20D x 33H
75	31.5W x 21.5D x 40H	26.5H x 20D x 33H
100	31.5W x 21.5D x 40H	30.5H x 20D x 35H
112	31.5W x 21.5D x 40H	30.5H x 20D x 35H
125	37.5W x 26.5D x 48H	33W x 23D x 38H
150	37.5W x 26.5D x 48H	33W x 23D x 38H
175	37.5W x 26.5D x 48H	34.5W x 26.5D x 42H
200	37.5W x 26.5D x 48H	34.5W x 26.5D x 42H
225	37.5W x 31.5D x 52H	34.5W x 26.5D x 42H
250	37.5W x 31.5D x 52H	37.5W x 26.5D x 48H
300	37.5W x 31.5D x 52H	37.5W x 26.5D x 48H
400	51.5W x 38D x 61H	43.5W x 33.5D x 55.5H
450	51.5W x 38D x 61H	43.5W x 33.5D x 55.5H
500	51.5W x 38D x 61H	43.5W x 33.5D x 55.5H
600	64W x 47D x 67H	51.5W x 38D x 61H
750	64W x 47D x 67H	Contact Factory

N. Seismic Qualification: been seismically qualified in accordance with: International Building Code, 2006/2009 Edition, California Building Code, 2007/2010 Edition, ASCE Standard 7, 2005 Edition to OSHPD CAN 2-1708A.5, Rev. , ICC-ES AC 156, Effective 01/01/2007, OSHPD approved: OSP-0110-10.

- a. Unit shall remain operational and shall not suffer electric or mechanical damage within the limits of a qualified seismic event.

- b. Certification Level: Short period spectral acceleration: $SDS = 1.5 \text{ g}$, Seismic importance factor: $I_p = 1.5$, Installation height: $z/h = 1.0$,  Installation restrictions: None - Valid for below grade, at grade and roof installations in floor mounted configuration.
- O. Insulation System:
 - 1. Shall be NOMEX-based with an Epoxy Co-polymer impregnant for lowest environmental impact, long term reliability and long life expectancy.
 - 2. Class: 220 degrees C
 - 3. Impregnant Properties for low emissions during manufacturing, highest reliability and life expectancy.
 - 4. Epoxy co-polymer
 - 5. VOC: less than 1.65 lbs/gal (low emissions during manufacturing)
 - 6. Water absorption (24hrs @25C): less than 0.05% (superior insulation, longer life).
 - 7. Chemical Resistance: Must have documented excellent performance rating by supplier.
 - 8. Dielectric Strength: minimum of 3200 volts/mil dry (for superior stress, overvoltage tolerance).
 - 9. Dissipation Factor: max. 0.02 @25C to reduce aging of insulation, extending useful life.
- P. TRANSFORMER OPTIONS TO BE INCLUDED ON THIS PROJECT:
 - a. Enclosure Options: NEMA 3R, indoor totally enclosed, stainless steel
 - b. Integrated long term Power & Energy Logger
 - i. Supports NFPA 70E/CSA-Z462 Arc Flash Standard to provide operating data without opening transformer enclosure.
 - ii. Basis of design: Equivalent or superior to Powersmiths Express Logger.
 - iii. Meter shall be factory-installed inside the transformer, connected to the transformer secondary, complete with fused voltage connections, revenue class 0.5 or better CTs.
 - iv. Access for meter setup, real time data viewing, event log, and downloading of logged data is via an integrated USB access port on the enclosure of the transformer.
 - v. Parameters measured include: V, I, PF, Hz, kW, kVA, kVAR, kWh, Ad, KWd, kVAd, kVARd, temperature, including the option to log min, max, average or instantaneous values of any of the parameters.
 - vi. The meter shall log real-time data at user selected intervals, as well as an event log when measured values have exceeded user defined thresholds.
 - vii. The logger shall be able to store a year of monthly peak demands.
 - viii. The logger shall be able to log up any 2 selected data points for over 10 years, more data points for shorter period.
 - c. Integrated load-side Revenue Grade Power & Energy Meter with communications options
 - i. Supports NFPA 70E/CSA-Z462 Arc Flash Standard to provide operating data without opening transformer enclosure
 - ii. Meter shall be factory-installed on the transformer, connected to the

- transformer secondary, complete with fused voltage connections, revenue class 0.3 CTs individually characterized to 0.1% and CT shunting block
- iii. Provide local display of real time energy and power quality information as it relates to the load fed from the transformer
 - iv. Parameters measured include: V, I, THD (V, I), PF, Hz, kW, kVA, kVAR, kWh, Ad, KWd, kVAd, kVARd
 - v. Communications: Modbus (serial over RS-232)
 - vi. **SELECT MODEL**
 - 1. Supply integrated meter having features described above (Basis of Design: Powersmiths SMART 2A).

d. Integrated Input and/or Output Breakers

i. General Requirements

- 1. Transformer integrated breaker assembly(ies) shall be separately enclosed from the main transformer coil & coil compartment, and the whole assembly shall remain rigid even with the transformer compartment covers removed.
- 2. The enclosure rating shall be meet or exceed the requirements for the transformer.
- 3. The breaker compartment(s) shall have provision for conduit access from the rear, bottom or side, and shall be front or top accessible for installation and service.
- 4. Each breaker shall be pre-wired to its respective transformer connection.
- 5. The transformer/breaker assembly shall carry as a minimum a field inspection certificate from a recognized agency assuring compliance to appropriate electrical codes.

ii. Input Breaker

- 1. The transformer shall be equipped with an integrated input breaker assembly.
- 2. The breaker shall have an overcurrent protection rating of 125% of transformer's nominal input full load current satisfying both US National Electrical Code and Canadian Electrical Code requirements. The breaker shall be rated for inrush current of a minimum of 10 times its nominal overcurrent rating.
- 3. The minimum breaker kAIC rating shall be determined by specifying engineer, as it depends on the service to which the assembly is connected.

iii. Single Output Breaker

- 1. The transformer shall be equipped with an integrated output breaker assembly.
- 2. The breaker shall have an overcurrent protection rating of

125% of transformer's nominal input full load current satisfying both US National Electrical Code and Canadian Electrical Code requirements. The breaker shall be rated for inrush current of a minimum of 8 times its nominal overcurrent rating.

3. The minimum breaker kAIC rating shall be sized appropriately for the available short circuit current of the transformer to which it is connected.

iv. Dual Output Breakers

1. The transformer shall be equipped with two integrated output breaker assemblies.
2. Each breaker shall have an overcurrent protection rating of up to 125% of transformer's nominal input full load current, or as specified by the specifying engineer, and satisfying both US National Electrical Code and Canadian Electrical Code requirements.
3. Each breaker shall be rated for inrush current of a minimum of 8 times its nominal overcurrent rating.
4. The minimum breaker kAIC rating shall be sized appropriately for the available short circuit current of the transformer to which it is connected.

e. Integrated Access Port to Transformer Output Voltages and Currents to enable spot checks of load profile measurement without opening transformer enclosure.

- i. Supports NFPA 70E/CSA-Z462 Arc Flash Standard to provide operating data without opening transformer enclosure.
- ii. Supply access to transformer output voltages and currents without opening the enclosure, via twistlock connectors, in support of NFPA 70E/CSA-Z462 Arc Flash Standard to avoid arc flash risk as associated with opening the enclosure of live equipment.
- iii. Currents shall be accessed via integrated FTRZ listed 333mV CTs.

f. Integrated Rotatable Infrared (IR) Viewing Port to address NFPA 70E/CSA-Z462 Arc Flash Standard.

- i. Provide integrated rotatable IR viewing port that provides single point viewing point that enables the thermal scanning of all live connections including primary and secondary feeder terminations and taps without requiring opening of the transformer enclosure or exposure to live parts.
- ii. The port shall be easily usable with a wide variety of makes and models of commercially available thermal scanning devices, without requiring any proprietary connectors, adapters or other components.

- iii. Basis of performance: Powersmiths Rotatable IR Viewing Port.
- iv. For the installation of one or more fixed IR windows to be considered an acceptable alternative on this project, the transformer manufacturer shall provide detailed drawings prepared by a qualified engineer detailing how all live terminals will be viewable. The manufacturer shall commit that should all terminals not be viewable, once installed, the manufacturer shall rectify the situation at his own expense.
- g. Lug Kit: Supply with standard screw-type lugs as specified at time of order.
- h. Lug Kit: supply with Compression lugs configured as specified at time of order.
- i. Electrostatic Shield: Each winding is independently single shielded with a full-width copper electrostatic shield [Double shields or triple shields may also be specified]
- j. TVSS: UL 1449 listed, with EMI/RFI Filtering. Rating: 80kA/mode [optional 120kA/mode, 160kA/mode]
- k. Low Inrush: less than 6 times primary full load current with a 3% source impedance.
- l. Enhanced Seismic Bracing: increases withstand to Short period spectral acceleration: SDS= 2.28
- m. Wall Brackets are available for transformers up to 75kVA where specified.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Follow all national, state and local codes with respect to transformer installation.
- B. Where sound level may be of concern, utilize the services of a recognized and established Acoustical Consultant to provide the proper installation environment to minimize noise and vibration.
- C. Check for damage and loose connections.
- D. Set the transformer plumb and level.
- E. Mount transformer on vibration isolation pads suitable for isolating the transformer.
- F. Provide Seismic restraints where required.
- G. Coordinate all work in this Section with that in other sections.

- H. Verify all dimensions in the field.
- I. Adjust transformer secondary voltages to provide the required voltage at the loads.
- J. Upon completion of the installation, an infrared scan shall be provided for all bolted connections. Correct any deficiencies. Repeat thermal scan 3 months after installation and prepare a report for the customer.

3.2 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and review test results.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in
 - 2. Follow NETA Acceptance Testing Specification.
 - 3. Certify compliance with tests.

3.3 PERFORMANCE VALIDATION

- A. To insure that the products shipped to the job site meet this specification, provide on-site revenue class accurate efficiency and harmonic measurements of transformers once installed and operating at customer's site. Data shall be collected from primary and secondary sides of the transformer simultaneously on a synchronized cycle by cycle basis. The use of two discrete meters that are not synchronized is not acceptable. Sampling shall be of 10% of transformers on the project once installed and operating, as selected by customer. Submit a detailed report to the project engineer.
- B. Where integrated metering has been specified to be connected to an external network, contractor to provide the required connection and commissioning to customer's specified system.
- C. Identify non-compliant products to the engineer and replace at no cost to the customer.

END OF SECTION 260675

SECTION 260700

PANELBOARDS

PART 1 - GENERAL

Applicable provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 WORK INCLUDED

- A. The work under this section shall include the furnishing of all materials, labor, tools and services necessary to install the panelboards and to complete all work shown on the Drawings or specified herein.

1.2 RELATED WORK

- A. Grounding
- B. Overcurrent Protection

1.3 SUBMITTALS

- A. Submit shop drawings for equipment and component devices under provisions of Division 1.
- B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
- C. Furnish two (2) sets of keys to Owner.

1.4 REFERENCES

- A. FS W-C-375 - Circuit breakers, molded case, branch circuit and service.
- B. FS W-P-115 - Power distribution panel.
- C. NEMA AB 1 - Molded case circuit breakers.
- D. NEMA KS 1 - Enclosed switches.
- E. NEMA PB 1 - Panelboards.
- F. NEMA PB 1.1 - Instruction for safe installation, operation and maintenance of panelboard rated 600 volts or less.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - PANELBOARD AND LOAD CENTERS

- A. Siemens.
- B. Square "D".
- C. General Electric.
- D. Or approved equal.

2.2 BRANCH CIRCUIT PANELBOARDS

- A. Lighting and appliance branch circuit panelboards: NEMA PB 1; circuit breaker type.
- B. Enclosure: NEMA PB 1; Type 1.
- C. Cabinet size: Approximately 6 inches deep; 20 inches wide for 240 volt and less panelboards. Verify field conditions and alter dimensions to suit at no additional cost.
- D. Provide surface cabinet front door-in-door with concealed trim clamps, concealed hinge and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.
- E. Provide panelboards with copper bus, rating as scheduled on Drawings. Provide copper ground bus in all panelboards and isolated ground bus in those as indicated on Drawings.
- F. Minimum integrated short circuit rating: 10,000 amperes rms symmetrical for 240 volt rated for 125 amps or less, 22,000 amperes rms symmetrical for 240 volt rated greater than 125 amps to 225 amps and 30,000 amperes for emergency power panelboards (verify in field). If panelboard is noted as a main distribution panelboard, than panel shall be rated as a distribution panelboard. Contractor shall provide short circuit study to ensure adequacy.
- G. Molded case circuit breakers: Bolt-on type thermal magnetic trip handle for all poles. Provide circuit breakers UL listed as type SWD for lighting circuits. Breaker handle to indicate ampere rating.

2.3 DISTRIBUTION PANELBOARDS

- A. Description: NEMA PB 1, circuit breaker type. The bus of all panels rated a minimum 400 amps shall be distribution type.
- B. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.
- C. Minimum integrated short circuit rating: 65,000 amperes rms symmetrical for 240 volt panelboards; 65,000 amperes rms symmetrical for 480 volt panelboards, unless otherwise noted on Drawings.

- D. Model Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR as specified on Drawings.
- E. Enclosure: NEMA PB 1, Type 1.
- F. Cabinet Front: Surface type, fastened with screws. Double hinged doors with flush lock, metal directory frame, finished in manufacturer's standard gray enamel. One hinged door to access breakers, the other to access wiring compartment.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards flush or surface mounted as indicated on Drawings.
- B. Mounting height maximum 6 ft. (2 m) to top circuit breaker.
- C. Provide filler plates for unused spaces in panelboards.
- D. Provide type written circuit directory for each branch circuit panelboard. Indicate loads served and panel name by matching that shown on panel schedules on Drawings. Revise directory to reflect circuiting changes required to balance phase loads. Provide a second copy and turn over to Owner.
- E. Provide 3/4" thick plywood backboard for mounting of panels. Paint backboard with fire retardant paint.
- F. Provide nameplates as indicated in Section 16550.

3.2 FIELD QUALITY CONTROL

- A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.
- B. Visual and mechanical inspection: Inspect for physical damage, proper alignment, anchorage and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches and fuses.
- C. Provide thermographic inspections in accordance with Section 26 0100.

3.3 TESTS

- A. Submit certification that each panelboard has withstood, without breakdown, a factory dielectric (Hi-Pot) test consisting of a one minute application of a 60 cycle AC test voltage applied between phase legs and from each phase leg to enclosure.

- B. The applied test voltage shall have an RMS value of at least twice the line to line system voltage to which the panelboard is to be applied, plus one thousand volts (minimum 1500V).

3.4 RECORD DRAWINGS

- A. Submit As-Built Drawings indicating the location of all panelboards.

END OF SECTION 260700

SECTION 260800

FIRE ALARM SYSTEM

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section. Submit shop drawings for checking and approval.

1.1 FIRE ALARM SYSTEM

- A. The existing fire alarm system is an addressable system. The fire alarm control panel is located in the boiler room.
- B. Add and modify as required to the existing system, as specified/shown on the drawings and as per field requirements. All devices shall be suitable for operation and compatible with existing system. Provide relays modules, cards, power supplies, etc. as required.
- C. Provide sufficient quantity of relays for fan shutdown as specified/shown on Drawings.
- D. Connect, test and leave the system in first class operating condition.
- E. The system shall maintain all applicable Local, State and National Codes including the National Electrical Code, NPFA-72, NFPA-101, ADA 1971 and NEC. The system shall be listed by Underwriter's Laboratories, Inc.
- F. The Electrical Contractor shall provide a manufacturers certified technician to supervise installation, adjustments, final connection and system testing.
- G. Fire alarm wiring and cable shall be per manufacturer's requirements.
- H. Fire alarm system test shall be in accordance with NFPA-72 and local fire department requirements.

END OF SECTION 260800

SECTION 260825

PUBLIC ADDRESS SYSTEM

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this Section. Submit shop drawings for checking and approval.

1.1 DESCRIPTION OF WORK

- A. The Contractor shall furnish all equipment, accessories and material required for the installation of communication devices in strict compliance with these Specifications and applicable Contract Drawings. Any material and/or equipment necessary for the proper operation of the system, which is not specified or described herein, shall be deemed part of this specification.

PART 2 - PRODUCTS

2.1 SPEAKERS

- A. Flush Speaker Baffles (ceiling): Ceiling Speakers shall be Rauland USO-188/ACC1000 white semi-gloss enamel steel grille with 8" speaker, 25/70 volt 7 watt transformer and 6 oz. magnet mounted on a # ACC1101 steel protective cover and a ACC1104 tile bridge support.
- B. Enhanced Staff Stations
 - 1. Room phones shall be Rauland Model 2554W-VP vandal proof, where indicated. Enhanced staff stations can dial administrative stations, initiate emergency calls, and enable or disable the reception of program material at their location. Depending upon the level of system access, enhanced staff stations can dial other staff stations, perform all-call, zone pages, conference calls and call transfer.
 - 2. Staff stations can be assigned to initiate calls at three levels; normal/emergency, urgent/emergency, and emergency. Emergency calls ring the administrative phone with a special tone and will interrupt a non-emergency call in progress. An integral emergency announce feature (no external amplifier necessary) gets prompt attention when needed by routing unanswered emergency calls to a designated emergency station. Emergency calls continue to ring until answered.

END OF SECTION 260825

SECTION 260900

GUARANTEE

PART 1 - GENERAL

Applicable Provisions of the Conditions of the Contract and Division 1 General Requirements govern work in this section.

1.1 GUARANTEE

- A. The Contractor shall remove, replace and/or repair at his own expense and at the convenience of the Owner, any defects in workmanship, materials, ratings, capacities and/or characteristics occurring in the work within one (1) year years or within such longer period as may be provided in the Drawings and/or Section of the Specifications, which guarantee period shall commence with the final acceptance of the entire Contract in accordance with the guarantee provisions stated in the General Conditions, and the Contractor shall pay for all damage to the system resulting from defects in the work and all expenses necessary to remove, replace, and/or repair any other work which may be damaged in removing, replacing and/or repairing the work.

END OF SECTION 260900

SECTION 274115
HEARING LOOP SYSTEMS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 RELATED DOCUMENTS

- A. Refer to hearing loop system drawings, appendix, and the project construction drawings for information related to the work specified herein.
- B. Audiovisual system documents include:
 - 1. AVE series drawings

1.3 SCOPE OF WORK

- A. Provide a Hearing Loop System that provides supplemental reinforcement of audiovisual system audio signals to listeners (presenters and audience members as appropriate) complete with all apparatus, equipment, power supplies, wiring, labor, and services necessary to ensure a complete working system.
- B. Verify completeness of equipment listed and correctness of type numbers.
- C. Provide supplementary equipment needed to meet system requirements, without claim for added payment.
- D. The work includes, but is not limited to, the following:
 - 1. Submission of shop drawings prior to fabrication
 - 2. Verification of dimensions and conditions at the job site
 - 3. Installation in accordance with these specifications, manufacturer's recommendations, and all applicable code requirements
 - 4. Setup and adjustment of signal processing, system tests and adjustments, written report, demonstration for approval, participation in acceptance tests, and final adjustments as required
 - 5. Coordination with the project Electrical Contractor
 - 6. Coordination with the Owner's Audiovisual Systems Contractor
 - 7. Coordination with Owner's Facilities Department
 - 8. Coordination with Owner's Audiovisual Personnel
 - 9. Performance standards, without claim for additional payment

10. System documentation
 11. Instruction of owner's operating personnel
 12. Maintenance services for one year
 13. Guarantee
 - E. Work not included
 1. Power, except for provision of power strips as noted
 2. Telephone or data system cabling
 3. Cable TV system cabling
 4. Audiovisual systems
 - F. Related Work Specified Elsewhere
 1. Carefully examine all of the Contract Documents for requirements which affect the Work of this Section.
 2. Other Specification Sections which directly relate to the Work of this Section include, but are not limited to, the following:
 - a. Section 01 00 00 - General Requirements
 - b. Section 26 00 00 – Electrical
 - c. Division 27 - Communications; including all Sections contained therein
- 1.4 CONTRACTOR QUALIFICATION AND CERTIFICATION
- A. Audiovisual Contractors shall have current certification from system manufacturer to test, install, and commission hearing loop systems.
 - B. Contractor shall have the ability to issue a Certificate of Conformity in accordance with IEC 60118-4.
 - C. BID SUBMITTALS
 1. Project Timeline and Project Resources
 - a. Offeror shall indicate acceptance of the attached RFP timeline with their bid. If any major exceptions are noted indicate with bid.
 - b. Offeror shall provide additional detail outlining procurement and installation time line immediately after the bid is awarded. During the bidding process offeror must verify that they have considered all of the various steps required for procurement, assembly and installation and have properly staffed the project to meet the indicated deadlines.
 - c. The submitted timeline shall indicate each task to be performed, expected resource allocation, and expected duration of each task. Also, indicate earliest start, earliest finish, latest start and latest finish for each major task. Note prominently expected task milestones, and expected payment milestones. Critical path shall be indicated in the timeline, along with a discussion as to the implications of slippage in the critical path. Offeror shall indicate any “long lead time” equipment or material items with their proposal that could hinder the timely

completion of the project. Include sufficient time for commissioning, inspection, tuning and adjustments by the Owner's designated representative at the completion of installation.

1.5 DEFINITIONS

- A. Furnish – Purchase and/or fabricate the item and deliver to site.
- B. Install – Perform the physical installation of the item on the site.
- C. Provide – Furnish and install item or items, complete with any and all required accessories.

1.6 MATERIALS AND EQUIPMENT

- A. Compliance
 - 1. The Hearing Loop system shall comply with IEC 60118-4:2006.
 - 2. A Certificate of Conformity to this standard shall be issued for each Hearing Loop System in the project.
- B. All systems proposed herein shall meet the best commercial practices of the applicable industries, except where alternatives are noted. Publications of issues of the following standards form a part of this specification:
 - 1. American Institute of Architects (AIA)
 - 2. Americans with Disabilities Act (ADA)
 - 3. American National Standards Institute (ANSI)
 - 4. Audio Engineering Society (AES)
 - 5. Federal Communications Commission (FCC)
 - 6. Institute of Cable Engineers (ICEA)
 - 7. Institute of Electrical and Electronic Engineers (IEEE)
 - 8. International Standards Organization (ISO)
 - 9. National Electric Code (NEC)
 - 10. National Electrical Manufacturers Association (NEMA)
 - 11. National Fire Protection Association (NFPA)
 - 12. Occupational Safety and Health Administration (OSHA)
 - 13. Underwriters Laboratories (UL)
 - 14. Nationally recognized standards of the various construction trades, as may be applicable.
- C. References shall meet the latest edition of that standard
- D. Equipment lists specify manufacturers' type numbers to indicate an acceptable standard of quality and performance. Substitutions of equal equipment beyond

the equipment listed will be permitted only if such equipment is an equal to the basis of design. Address requests for listing of substitutions to the Owner's Designated Representative. With any request for substitution, include measured data proving the equivalence of the proposed substitute in quality and performance. The Owner's Designated Representative shall be the final judge of the validity of the data submitted.

- E. Provide only current-model materials and equipment. Do not provide obsolete or discontinued models unless specifically directed to do so in the Equipment section of this specification. Review all materials and equipment immediately prior to installation, and inform the Owner's Designated Representative of any obsolete or discontinued items.

1.7 FEES, PERMITS, AND NOTICES

- A. Perform all work in compliance with all applicable requirements of the authority(ies) having jurisdiction. Take out and maintain all construction permits, pay all fees, and file all notices, all at no additional cost to the Owner.

1.8 COORDINATION AND CLARIFICATION

- A. Refer to the awarding authority before the bid date for coordination and clarification of any discrepancies among drawings and specifications. Where discrepancies occur and pre-bid instructions have not been obtained, abide by the Owner's Designated Representative's reasonable decisions.

1.9 EXISTING CONDITIONS - EXAMINATION OF SITE AND DOCUMENTS

- A. Bidders are expected to examine and to be thoroughly familiar with all contract documents and with the conditions under which work will be carried out. The Awarding Authority will not be responsible for errors, omissions and/or charges for extra work arising from General Contractor's or Trade Contractor's failure to familiarize themselves with the Contract Documents or existing conditions. By submitting a bid, the Bidder agrees and warrants that he has had the opportunity to examine the site and the Contract Documents, that he is familiar with the conditions and requirements of both and where they require, in any part of the work a given result to be produced, that the Contract Documents are adequate and that he will produce the required results.
- B. Verify all existing conditions. Refer to the Owner's Designated Representative for coordination and clarification before the bid date of any discrepancies concerning existing conditions. Clarify with the Owner's Designated Representative all locations including conduit and cable routings. Where discrepancies occur and pre-bid instructions have not been obtained, abide by the owner's designated representatives reasonable decision.
- C. Provide and terminate all required wire and cable into conduit provided by others.
- D. Comply with all requirements regarding the use of cable with respect to spread of fire. Refer to the General Construction drawings for identification of air plenum and other spaces having special cabling requirements. Field-survey the jobsite

to determine spaces having special cabling requirements. It is the responsibility of the Contractor to provide wiring that is in compliance with all applicable building codes of the authority(ies) having jurisdiction.

1.10 SUBMITTALS

A. General

1. Refer to Submittals in Division 1 for submittal provisions and procedures.
2. Submittals that do not include all of the specified items or do not adhere to the criteria set forth below will be returned without review.
3. Copies: Submit a minimum five (5) copies of all required submittals. Include with each submittal electronic copies on CD-Rom or USB stick of all files as PDF organized by room and types in same manner as paper submittal.

B. Field Verification

1. At the earliest opportunity in the project, provide evidence that the background magnetic noise in the areas designated for loop coverage is within the limits defined in the standard, IEC 60118-4:2006. Where the background magnetic noise exceeds -32dB re: 400mA/m-1 [-22dB for short-term use/localized applications], the contractor shall not proceed without client approval.
2. Prior to installation, show that cross-talk between adjacent looped areas (whether part of this contract or not), and that magnetic spill from any Hearing Loop System where the signal is defined as 'confidential' will, by design, be less than -40dB with normal signal levels.
3. Prior to installation, provide evidence that the effect of metal within the structure of the building has been adequately assessed and compensated for by loop design and / or appropriate loop driver selection. Where necessary, the effect of metal shall be assessed by site survey and using test loops on relevant construction, carried out by a competent test specialist.
4. Prior to installation, provide calculations to demonstrate that the field strength of the proposed systems will meet the requirements of the standard IEC 60118-4:2006.

C. First Submittal

1. Timing: within 14 days of contract award
2. Conduit size verification
 - a. Review and confirm that audiovisual system conduit as shown on the Drawings and where applicable, as built drawings, is sufficient and appropriately sized for system.
 - b. Note where conduit system is not sufficient and indicate any additional conduit required for system.
3. Milestone dates

- a. Dates for each Submittal
 - b. Shop fabrication complete
 - c. Initial equipment ship to site
 - d. Start of installation
 - e. Second equipment ship to site
 - f. Field testing
 - g. Correction of punch list items
 - h. Training
- D. Second Submittal
 - 1. Timing: 45 days before equipment purchase or commencement of wiring
 - 2. Field Verification Report
 - a. Submit report summarizing results of field verification tests and calculations described above.
 - 3. Product Data Sheets
 - a. Submit all product data sheet and drawings in a single submittal, except if specified otherwise.
 - b. Before ordering equipment or beginning work, submit to the Owner's Designated Representative for approval a list showing quantities and manufacturer and model number for items of equipment to be used in assembling this system, including all items of equipment specified herein. Attach copies of catalog sheets for all items of equipment submitted.
 - c. Submit cut sheets in same order as this specification with table of contents, specification paragraph reference and page numbers.
 - 4. Shop Drawings
 - a. A block diagram indicating proposed interconnections of all equipment and indicating equipment types and model numbers.
 - b. Drawings showing cable pull assemblies and schedule complete with all wiring requirements for the project
 - 5. Commissioning Plan
 - a. Submit method statement for commissioning described below.

1.11 DELIVERY, STORAGE AND HANDLING

- A. All equipment shall be appropriately packed for shipment.
- B. All shipping costs to the job site are the responsibility of the Contractor. Determination of the shipping method and company is the responsibility of the Contractor in order to meet the published project schedule.
- C. Completed systems shall be shipped FOB inside and in place.
- D. Note that drop shipment of equipment to the Owner's site directly from the manufacturer, or other supplier will not be allowed.
- E. Upon delivery all materials shall be stored under cover in a clean and dry location. Materials which are damaged during shipping, storage or handling or are

otherwise not suitable for installation shall be removed from the job site and replaced, at no additional cost to the Project, with acceptable materials.

1.12 CLEANUP AND TRASH DISPOSAL

- A. Maintain a clean working area free from debris and waste materials. Clean work areas daily.
- B. Except for items to be reused or returned to the Owner, or as otherwise directed, remove trash and packing materials from the jobsite, and dispose of offsite in a legal manner. Do not allow trash to accumulate at the jobsite.

1.13 FUNCTIONAL REQUIREMENTS

A. Hearing Loop System

- 1. Provide a magnetic induction hearing loop system for supplemental reinforcement of audio signals to audience members with hearing loss using hearing aids with T-coils or wireless beltpack receivers with earphones.
- 2. Provide continuous hearing loop system coverage throughout the entire space using phased arrays.

1.14 DIAGRAMS, INSTRUCTION MANUALS

- A. Provide draft copies of all required diagrams and instruction manuals on-site for inspection during the demonstration and acceptance testing of the system; submit final copies thereafter.
- B. Simplified Line Diagram
 - 1. Show the essential parts of the completed installation and their functional relations, including connections to other system. Mount one copy of the diagram behind clear plastic on the wall near the equipment rack, or as directed. Bind one copy of the diagram into each instruction manual. Reduce the mounted copy to 11" x 17" maximum; ensure that it is legible at that size.
- C. Operating Manual
 - 1. Create system specific user manual for the complete system including user instructions for accessing all the system functionality specified in Functional Requirements. Manual should describe how to use individual components in their context as part of a larger system. A compilation of manufacturer's manuals for components does not meet this requirement.
- D. Complete Instruction Manuals
 - 1. Provide complete instruction manuals which include the following:
 - a. Table of contents.
 - b. List of loose items furnished.
 - c. List of functional requirements.
 - d. Operating manual (described above).

- e. List of settings and adjustments for semi-fixed controls.
- f. Manufacturer's sheets of specifications, operating instructions, and service information, arranged alphabetically by manufacturer and then by model number, for each item of equipment specified herein.
- g. Detailed system wiring diagrams, including cable schedule and copies of all drawings specified above. Also include all submitted shop drawings to indicate as-built conditions.
- h. List of any special tools or equipment required for system maintenance.
- i. List of consumables such as batteries or lamps and spare parts and recommended stock level.
- j. List of all manufacturers in system with addresses and support telephone numbers.
- k. Provide five (5) bound copies.

E. Record Drawings

- 1. Provide record drawings of as-built conditions in AutoCAD and PDF file format based on contractor's updated base drawings. Drawings shall include at a minimum:
 - a. Device location plan
 - b. Functional diagram with wire numbering
- 2. Provide USB memory stick with AutoCAD files and one (1) blackline print of drawings.

1.15 INSTRUCTION

- A. Provide instruction to Owner's designated operating personnel. Include a minimum of one (1) two hour session of instruction in the operation, care and maintenance of the installation.
- B. Schedule instruction at the mutual convenience of the Owner and contractor after demonstration and acceptance testing. Provide a video recording, or otherwise coordinate with the Owner the video recording, of all instruction sessions and provide a copy of each major session to the Owner.

1.16 GUARANTEE, SERVICE, MAINTENANCE AND SUPPORT

- A. Provide complete warranty, maintenance, and support program for a period of one year from the date of final acceptance of the system, regardless of the terms stated by equipment manufacturers. Final acceptance shall be deemed to include clearing all punch list items and delivering final documentation.
- B. Guarantee all equipment and installations to be free of faulty workmanship and defective components for a period of one year from date of final acceptance. Cover all equipment provided under this section. During this time, replace defective material and repair faulty workmanship at no charge to the Owner.
- C. During this period, replace defective materials and repair faulty workmanship within 24 hours of report of malfunction at no additional cost to the Owner. If

specified materials and installations cannot be made good within 24 hours of report of malfunction, provide approved temporary alternate equipment and facilities, complete and operational, within 24 hours of report of malfunction, at no additional cost to the Owner.

- D. Maintain a 10-hour-per-day, normal business hours (8AM to 6PM) telephone response facility for receipt of service calls.
- E. Provide telephone response by qualified support technician within one hour of receiving a service request,. Provide service within eight business hours by the arrival of a technician, if required. Provide this telephone and on-site service during normal business hours (8:00am - 6:00 PM), five days per week.
- F. If any equipment item is found not to be quickly repairable, and thus be unavailable for use by the Owner for a period greater than 24 hours, and upon request from the Owner, make available a functional replacement unit at no charge. Install this replacement unit in a timely fashion so that system operation is restored within a 24 hour period from the initial failure. Provide such replacement unit to the Owner until the original unit is repaired and reinstalled.
- G. At the completion of the program, provide to the Owner a record of all work performed and parts replaced.
- H. Provide at no additional charge preventive maintenance service for a period of one year after final acceptance of installation. This service shall consist of at least two semi-annual visits to the site for checking and adjustment of equipment. During these visits, install any software or firmware upgrades to the extent these upgrades are made available at no charge from the manufacturer and are approved in advance by the Owner.
- I. For the duration of the program, provide or perform all services required as part of manufacturer's annual maintenance agreements or other manufacturer-imposed conditions. Maintain all content and software use licenses. Continue or extend all specified manufacturer support agreements and extended warranties. Pay all costs and fees; provide complete services package so that no charges are incurred by the Owner during the term of the program. To the extent that any manufacturer requires direct invoicing to the Owner, carry such costs within the contract price, with the understanding that such costs may be assigned to the Owner upon further discussion.
- J. Provide with bid annual cost to extend the preventive maintenance agreement from two to five years after completion.

PART 2 - EQUIPMENT

2.1 HEARING LOOP SYSTEM WIRING

A. Hearing Loop Drivers

1. Each induction loop driver shall have the following characteristics:
 - a. 'Current drive' output
 - b. Rated current and voltage capable of driving the designed loop without clipping or distortion of the signal with full power bandwidth up to at least 1.6 kHz
 - c. Capable of delivering the rated current and voltage into a load with 1 kHz sinewave signal for at least 20 seconds continuously without damage to the unit or interruption of the output signal
 - d. Frequency response from 80Hz to 6.5kHz
 - e. THD+N less than 0.2% at 1 kHz sine at full current
 - f. Automatic Gain Control (AGC) optimized for speech, with a dynamic range greater than 36dB
 - g. Metal loss correction with an adjustable gain slope range of at least 0 dB to +3 dB per octave
 - h. All audio inputs to be balanced.
 - i. Front panel indication of audio signal activity on the output of the unit and where possible the input
 - j. Adjustment of controls for commissioning shall be achievable without exposure of terminals carrying hazardous voltages.
 - k. All AC powered devices shall have passed testing at a Nationally Recognized Testing Laboratory (NRTL) for safety with reference to the current edition of UL 60065 and any other applicable safety standards.
2. Where two-phase systems are required, a single unit shall be provided that is capable of driving two separate outputs with a 90° phase shift accurate to $\pm 1^\circ$ from 100 Hz to 5 kHz, or two identical drivers shall be provided unless it can be demonstrated in the system design that this is not appropriate. If two identical drivers are appropriate, in addition to the requirements above, each driver shall have the following characteristics:
 - a. Slave input/output socket providing an insert point after the input AGC but before the output drive control
 - b. Auxiliary power outlet on rear panel with $\pm 15V$ dc, 150mA minimum capacity
 - c. Front panel indicators to indicate separate fault conditions of overload, overheat and loop error

B. Hearing Loops

1. Loops connected to the Hearing Loop system shall meet the following requirements:
 - a. The Hearing Loop System shall be designed and implemented to meet all requirements of IEC 60118-4:2006.
 - b. The implementation of the hearing loop design shall take into account the layout and construction materials of the building.
 - c. Appropriate materials for the installation location shall be used (e.g. wire in the floor/ceiling, flat copper tape under floor coverings, or a purpose-designed loop coil inside a counter vertical front).
 - d. Loop wire containment shall be of non-metallic construction (to avoid short circuit grounding paths parallel with the loop wire). This restriction does not apply to the loop feeder cables between a loop amplifier and the start of the loop itself, which may be installed in metal or non-metal containment.
 - e. Where flat copper tape is accepted for use under carpet or other floor coverings, this does not require the use of containment and shall be installed according to the manufacturer's recommendations and current best practice.
 - f. Implementation of the loops shall in general follow best practices.
2. Copper Cable Installation for direct burial within concrete floor
 - a. Provide sufficient length at the end of the copper cables to allow transitioning to the feeder cable soldering points.
 - b. Twist feeder cables tightly per manufacturer recommendations.
 - c. Provide a minimum of 12 inches of separation from other cables types.
 - d. Acceptable Direct Burial Cable
 - 1) Williams AV ACDB25###
 - a) Quantity: Length as required

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide appropriate cabling and/or connection points for system integration.
- B. Wire and connect to all items of equipment in accordance with the manufacturers' recommendations.
- C. Provide all necessary and supplementary grounding conductors and connections to each component or item of equipment.
- D. Follow good audio and other relevant practice to ensure that proper grounding and other cable system design does not cause degradation of this or other system performance by allowing interference in inappropriate paths.
- E. Confirm locations of all local power supply requirements and equipment spatial requirements.
- F. Supply and install any racks, wire, conduits, pull boxes, junction boxes and raceways required to provide a complete system. Unless specifically instructed to the contrary, install all system wiring in steel conduit. Do not exceed 30% fill in conduits.
- G. All wiring of loops and between equipment locations shall be installed and concealed in appropriate containment.
- H. Ensure complete segregation of the Extra-Low Voltage (ELV) wiring system, from any other ELV or Low Voltage (LV) wiring system.
- I. Secure equipment firmly in place. Make fasteners and supports adequate to support their loads with a safety factor of at least three.
- J. All wiring, including that inside equipment enclosures or racks, will be of a neat and tidy appearance. Wiring shall be identified at both ends of each cable.
- K. Take precautions to prevent electromagnetic and electrostatic hum. Install the equipment to provide safe operation.
- L. Use terminal strips or blocks in all audio lines entering or leaving the system equipment rack(s). Make all joints and connections with rosin-core solder or with mechanical connectors appropriate for the service. Execute all wiring in strict adherence to standard broadcast practices.
- M. Assemble and install equipment racks to permit access to connections and adjustments on the rear of rack-mounted components and to permit removal of components for servicing. For any components which, for purposes of adjustment or calibration, must be removed from an equipment rack while in use, provide adequate service loops on all connecting cables.
- N. Install work neatly, with boxes, equipment, etc., plumb and square. Keep the job adequately staffed at all times. Designate an employee as field supervisor to be present on the job site and in responsible charge during all phases of installation and check-out. Maintain same supervisor through completion of the work unless

the designated supervisor ceases to be an employee or unless by mutual agreement with the Owner or Architect. Install the system in cooperation with other trades in order to achieve coordinated progress and satisfactory final results. Watch for conflicts with work of other trades on the job. Execute, without claim for extra payment, moderate moves or changes as are necessary to accommodate other equipment or preserve symmetry and pleasing appearance.

- O. Clearly, consistently, logically and permanently mark switches, connectors, jacks, relays, receptacles, cables, and cable terminations. Engrave and paint-fill all panel and receptacle markings, directly on the material on which controls or receptacles are mounted. Fill engraving with black or white paint, whichever contrasts best with panel finish, or as directed by the Architect. Use no hand-lettering, embossed tape (e.g. "Dymo" labels), or any adhesive- or otherwise mechanically-attached labels for any labels visible to operators or public during normal system operation. Use adhesive- or screw-attached engraved or laminated labels (e.g., "Kroy" or "Brother") on manufactured assemblies, such as amplifiers, which otherwise would require disassembly for direct engraving. Use printed adhesive cable markers to mark cables, or other labels intended for the purpose. Use "Kroy" or "Brother" or similar machine-produced laminated labels, or "letter quality" or "near letter quality" mechanically-produced lettering for patch panel labels. Insert patch panel labels into clear plastic-covered label holders.
- P. Paint or provide approved factory finishes for all system components exposed to public view as directed by Architect. Paint or otherwise remove all visible manufacturers' trademarks exposed to public view as directed by Architect.
- Q. If any item of equipment includes exposed controls which are not used in system operation, and if those controls cannot be locked, capped, or concealed behind a security cover, mount said item of equipment recessed behind a blank rack panel.
- R. Save all unused products accessories and turn over to Owner at checkout.
- S. Coordinate with other relevant contactors to ensure that all appropriate audio signals are connected to the induction loop system and transmitted clearly.
- T. Ensure that all aspects of the installation are in accordance with appropriate (AHJ) Authority Having Jurisdiction.

3.2 PROTECTION AND REPAIR OF EXISTING FINISHES AND STRUCTURES

- A. Cut and patch all holes required for this installation.
- B. Make good all materials and finishes cut into or damaged during installation.
- C. On completion, remove all rubbish and unused materials from the premises, clean the premises where dirtied, and clean all equipment, removing all dirt, dust, stains, and fingerprints.

3.3 ELECTRONIC TEST EQUIPMENT

A. Field Strength Meter

1. For commissioning, the Contractor shall use a field strength meter capable of commissioning to the requirements of IEC 60118-4:2006. The meter shall have the following characteristics:
 - a. Calibrated reading of 0 dB at 400 mA/m RMS as per IEC 60118-4:2006
 - b. True RMS measurement with 125 mS time constant
 - c. Class 2 meter as defined in IEC 61672-1:2003 (Electroacoustics – Sound level meters)
 - d. A-Weighted background noise range of at least -42 dB to -12 dB
 - e. Field strength measurement range of at least -22 dB to +8 dB, with increments of 1 dB from -3 dB to +3 dB
 - f. Frequency band mode with 1/3 octave frequency bands centered on at least 100 Hz, 1 kHz, and 5kHz meeting IEC 61260:1996 and IEC 60118-4:2006
 - g. Headphone output for listening to the hearing loop signal
 - h. Instructions for setting up a Hearing Loop System to IEC 60118-4:2006 by use of the field strength meter

3.4 INITIAL POST-COMPLETION TESTS AND ADJUSTMENTS

A. Perform these tests and adjustments. Furnish equipment necessary to perform these tests, and perform work required to modify the performance of the system in accordance with this specification.

1. Freedom from Parasitic Oscillation and Radio-Frequency Pick-up
 - a. Check to ensure that the system is free from spurious oscillation and radio-frequency pick-up, both in the absence of any audio input signal and also when the system is driven to full output.
2. Gain Control Settings
 - a. Establish tentative normal settings for all gain controls. Adjust all gain controls for optimum signal-to-noise ratio and signal balance.
3. Freedom from Switching Transient Noise
 - a. Eliminate audible clicks or pops produced by the operation of any controls.
4. Listening Test
 - a. Listen to normal program material to be sure that there are no audible defects.

B. Commissioning

1. The Contractor shall:
 - a. Test and commission the complete system(s) in accordance with IEC 60118-4:2006.

- b. Provide a method statement for testing and commissioning. Provide all necessary test equipment to complete the works, all test results to be fully recorded, and copies provided with the Operation and Maintenance manuals.
- c. Provide a minimum of 14 days notice of all testing in order that a Client's representative may have reasonable option to attend and witness tests.
- d. When carrying out commissioning tests, use a Field Strength measurement tool with a minimum specification as in section paragraph 3.3A above.
- e. Issue Certificates of Conformity to IEC 60118-4:2006 that clearly state the results of testing and whether the system performance meets the relevant requirements of the standard.

C. Report

- 1. Upon completion of above tests and adjustments submit two copies of a written report presenting test results, including numerical values and corrective actions taken, for review by the Architect and Consultant prior to demonstration and acceptance testing. With this report, submit written certification that the installation conforms to the requirements stated herein, is complete in all respects, and is ready for inspection and testing by the Architect.

3.5 DEMONSTRATION AND ACCEPTANCE TESTING OF COMPLETED INSTALLATION:

- A. Upon approval of the above test report by the Architect and at a mutually agreeable time, demonstrate operation of each major component and of the complete installation. After demonstration, assist as required in acceptance tests.
- B. Listening Tests
 - 1. Tests will include subjective evaluation by observers listening at various positions under various operating conditions of the system, intended to test its operation in conformance with its functional requirements.
- C. Equipment Tests
 - 1. Perform any measurements of frequency response, distortion, noise or other characteristics and any operational tests deemed necessary by the Architect to determine conformity with these requirements.
 - 2. If the need for adjustment or modification becomes evident during demonstration and testing, continue working until the installation operates properly.
- D. Final Adjustments
 - 1. Make control adjustments as directed by the Architect. Make a record of these control settings. Provide covers, caps, or shaft-locks for controls not used in system operation.

END OF SECTION

SECTION 274116

INTEGRATED AUDIOVISUAL SYSTEMS

PART 1 - GENERAL

1.1 General Provisions

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.
- B. Examine all other Sections of the Specifications for requirements that affect work of this Section whether or not such work is specifically mentioned in this Section.
- C. Coordinate work with that of all other trades affecting, or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.
- D. Throughout this specification, the term "Contractor" shall refer to the Audiovisual Systems Contractor unless otherwise indicated.

1.2 Examination Of Site And Documents

- A. Bidders are expected to examine and to be thoroughly familiar with all contract documents and with the conditions under which work will be carried out. The Awarding Authority (Owner) will not be responsible for errors, omissions and/or charges for extra work arising from General Contractor's or Trade Contractor's failure to familiarize themselves with the Contract Documents or existing conditions. By submitting a bid, the Bidder agrees and warrants that he has had the opportunity to examine the site and the Contract Documents, that they are familiar with the conditions and requirements of both and where they require, in any part of the work a given result to be produced, that the Contract Documents are adequate and that he will produce the required results.

1.3 DOCUMENTS

- A. Refer to audiovisual system drawings, appendix, and the project construction drawings for information related to the work specified herein.
- B. Audiovisual system documents include this printed specification plus the following drawings:
 - 1. AVE series drawings

1.4 RELATED DOCUMENTS

- A. Drawings, General Conditions of the Contract, and Division 1 General Requirements apply to the work of this Section. Examine referenced documents for requirements affecting the work.
- B. Examine all other Sections of the specifications and all other drawings for requirements which affect work under this Section, whether or not such work is specifically mentioned in this Section.

1.5 Related Work Specified Elsewhere

- A. Carefully examine all of the Contract Documents for requirements which affect the Work of this Section.

1.6 SCOPE OF WORK

- A. Provide all equipment outlined herein and assemble it into one complete functioning system, as described by the applicable paragraphs of this Section and as shown on the drawings. Assume responsibility for providing and installing systems that meet the performance requirements stated.
- B. The plans, specifications, and other Contract Documents are to be considered together and are intended to be mutually complementary, so that any work shown on the plans though not specified in the specifications, and any work specified in the specifications though not shown on the plans, is to be executed by the Contractor as a part of this contract. Should a conflict occur in or between or among any parts of the Contract Documents that are entitled to equal preference, the better quality or greater quantity shall govern, unless the Owner's authorized representative directs otherwise. Figured dimensions shall take precedence over scaled dimensions.
- C. To meet these performance requirements:
 - 1. Furnish all equipment, including any items not specified but required to provide a completed system. Verify the completeness of equipment listed in this Section and the correctness of type numbers.
 - 2. Use all equipment specified in the manner specified. Clarify any misunderstandings prior to bid submission, and offer alternates as appropriate.
 - 3. Verify each component's conformance with its manufacturer's published specifications and other requirements as stated in this Section.
 - 4. Check in detail each item of equipment provided, each portion of the installation, and the complete installation to ensure that the intent of this Section is achieved.
- D. The work includes, but is not limited to, the following:
 - 1. Submission of shop drawings prior to fabrication

2. Verification of dimensions and conditions at the job site
3. Installation in accordance with these specifications, manufacturer's recommendations, and all applicable code requirements
4. Setup and adjustment of signal processing, system tests and adjustments, written report, demonstration for approval, participation in acceptance tests, and final adjustments as required
5. Programming and documenting of all software controlled devices including initial setup of presets in all devices
6. Coordination with the Electrical contractor
7. Coordination with the Lighting contractor
8. Coordination with the Fire Alarm Systems Contractor
9. Coordination with Tel/Data Contractor and other Low Voltage Contractors
10. Coordination with Owner's Audio-Visual Personnel
11. Coordination with the Owner's IT department and installers
12. Performance standards, without claim for additional payment
13. System documentation
14. Instruction of Owner's operating personnel
15. Maintenance services for one year
16. Warranty

1.7 SUBSTITUTIONS

- A. Furnish explanation of any suggested substitute equipment or methods, identifying the impact on equipment, installation, and change in overall price. State the system price as specified, and any change in price due to this substitution. State clearly the benefit offered by this substitution. Provide manufacturer's specifications or other descriptive literature as appropriate. If requested, make samples available, at no cost to the Owner.

1.8 EXISTING CONDITIONS

- A. Verify all existing conditions. Refer to the Owner for coordination and clarification before the bid date of any discrepancies concerning existing conditions, drawings, and specifications. Clarify with the Owner all locations including conduit and cable routings. Where discrepancies occur and pre-bid instructions have not been obtained, abide by the Owner's decision.
- B. Provide all additional conduit and cable required for the installation. Refer to drawings of other Sections for identification of conduit and cable provided by other trades.
- C. Comply with all requirements regarding the proper installation of equipment for seismic considerations. It is the responsibility of the Contractor to employ installation methods that are in compliance with all applicable building codes of the authority(ies) having jurisdiction.

1.9 FEES, PERMITS, AND NOTICES

- A. Perform all work in compliance with all applicable requirements of the authority(ies) having jurisdiction. Take out and maintain all construction permits, pay all fees, and file all notices, all at no additional cost to the Owner.
- B. Where mounting or rigging systems require the design or design approval of a licensed Structural Engineer, pay all associated fees and expenses. Make no claim for additional payment.

1.10 MATERIAL AND EQUIPMENT

- A. Provide materials and equipment conforming to the applicable requirements of:
 - 1. Underwriter's Laboratories
 - 2. National Electrical Code
 - 3. American National Standards Institute
 - 4. Federal Communications Commission
- B. References shall meet the latest edition of that standard.
- C. Provide materials and equipment new and free from use, and covered by the applicable manufacturer's warranty.
- D. Notify the Owner if, in the Contractor's opinion, superior performance can be obtained from alternate materials or equipment from that identified in this specification.
- E. Certain items of equipment are specified by manufacturers' type numbers to indicate an acceptable standard of quality and performance. Substitutions of equal equipment beyond the alternatives listed will be permitted only if such equipment is listed in an addendum to this specification. Address requests for listing of substitutions to the Architect. With any request for substitution, include measured data proving the equivalence of the proposed substitute in quality and performance. The Architect shall be the final judge of the validity of the data submitted.
- F. Provide only current-model materials and equipment. Do not provide obsolete or discontinued models unless specifically directed to do so in the Equipment section of this Section. Review all materials and equipment immediately prior to installation, and inform the Owner's authorized representative of any obsolete or discontinued items.

1.11 DELIVERY, STORAGE AND HANDLING

- A. All equipment shall be appropriately packed for shipment.
- B. All shipping costs to the job site are the responsibility of the Audiovisual Contractor. Determination of the shipping method and company is the responsibility of the Audiovisual Contractor in order to meet the published project schedule.
- C. Completed systems shall be shipped FOB inside and in place.
- D. Note that drop shipment of equipment to the Owner's site directly from the manufacturer, or other supplier will not be allowed.
- E. Upon delivery all materials shall be stored under cover in a clean and dry location. Materials which are damaged during shipping, storage or handling or are otherwise not suitable for installation shall be removed from the job site and replaced, at no additional cost to the Project, with acceptable materials.

1.12 CLEANUP AND TRASH DISPOSAL

- A. Maintain a clean and safe working area free from debris and waste materials. Clean work areas daily.
- B. Except for items to be reused or returned to the Owner, or as otherwise directed, remove trash and packing materials from the jobsite, and dispose of offsite in a legal manner. Do not allow trash to accumulate at the jobsite.

1.13 SUBMITTALS

- A. Submittal Format. Unless directed otherwise, provide submittals electronically in PDF format. Provide documents in full size and suitable for printing by the reviewer. Clearly identify each document within its file name.
- B. Equipment List. Before ordering equipment or beginning work, submit to the Owner's authorized representative for approval a detailed list showing quantities and manufacturer and model number for items of equipment to be used in assembling these systems, including all items of equipment, accessories, and installation materials specified herein. For each item, indicate quantity to be employed within each room or subsystem, and total quantity. Provide this list not later than 30 calendar days after execution of the contract. With this list, provide a statement of assurance that the system design has been reviewed in its entirety, and that the Equipment List defines all equipment and materials necessary for the project.
- C. Product Literature. With the equipment list, attach product literature for all items of equipment submitted, identifying the function, connections, weight,

dimensions, mounting method, electrical and cooling requirements, and other descriptive information for each item, and including a color photograph. Where literature serves more than one item (e.g. varying sizes, finishes, channel counts, etc.), mark to indicate intended item. Order these data sheets alphabetically by manufacturer or in sequence as the referenced equipment appears in the specification. Do not organize by space where the referenced equipment is employed. Provide manufacturers' published data sheets; do not provide third-party catalog pages or HTML pages.

- D. Shop Drawings. Submit the following items for approval by the Owner's authorized representative before starting work. Provide full-size drawings, with text size not smaller than 10-point when printed at full scale.
 - 1. Drawings showing locations and mounting methods for all wall and ceiling mounted equipment. Show geometry of any projection systems.
 - 2. Drawings showing fabrication details of custom millwork and metalwork items,
 - 3. Drawings of rack and other equipment elevations.
- E. Report of Post-Completion Tests. Prepare a report on the post-completion tests defined in this section identifying the failure of any subsystems to perform as required in this Section.
- F. System Documentation. Submit a draft of the final system documentation for approval prior to its publication. Provide draft copies of all items on-site for inspection during the demonstration and acceptance testing of the system; submit final copies thereafter.
- G. Training Materials. Submit a draft outline of the training program and preliminary copies of any materials to be distributed during the program.
- H. Acceptance Test. Submit a draft of the final system acceptance test for approval prior to its performance.

PART 2 - EQUIPMENT

2.1 Installation Components

A. Ceiling Mounted Equipment Rack

1. Provide Ceiling mounted Equipment Rack complete with power and additional mounting kit. Provide 4RU Ceiling Rack
 - a. FSR CB-224S with strut hangers as needed
 - b. Atlas IED equal
 - c. Chief CMS492 equal
 - 1) Quantity: As Shown on drawings

B. Flat Panel Display Storage Box and Mount

1. Provide flat panel display mount, storage box and complete integrated system. Provide system capable of fitting between standard studs without horizontal brace. Provide mount rated for 350 lbs and that supports standard VESA mounting patterns through pull-out mount. Provide with internal box space of 24 inches x 20 inches and minimum of 3.75" depth. Provide with 8 Single gang box knockout s. Provide system capable of supporting an additional 10 inch x 7 inches capacity underneath the display for optional auxiliary equipment.
 - a. RP Visual Wallmate 32 Max
 - b. Advanced Mounting and Design Custom Colossal Self Supported
 - c. Custom Display Solutions Custom
 - 1) Quantity: As Shown on Drawings

PART 3 - EXECUTION

3.1 SYSTEM INSTALLATION

- A. Supply racks, wire, conduits, and raceways required to provide a complete system. Unless specifically instructed to the contrary, install all system wiring in steel conduit. Do not exceed 30% fill in conduits. Insulate all conduit from the equipment rack(s); connect conduits mechanically and electrically to the system ground point. Coordinate with the Owner and the Owner's authorized representative.
- B. Use separate wiring pathways for microphone-level circuits (below -20 dBm), video and line-level audio circuits (up to +30 dBm), loudspeaker circuits (above +30 dBm), control circuits, and power circuits. Space all low-voltage pathways far from power circuits per conduit separation distances table shown on drawings.
- C. Secure equipment firmly in place, including projectors, control panels, loudspeakers, conduit, amplifiers, racks, cables, etc. For all overhead mounted devices, provide secondary attachment to provide support in case of failure of primary support. Make fastenings and supports adequate to support their loads with a safety factor of at least three.
- D. Assemble and install equipment racks to permit access to connections and adjustments on rear of rack mounted components and to permit removal of components for servicing. For any components which, for purposes of adjustment or calibration, must be removed from an equipment rack while in use, provide adequate service loops in all connecting cables.
- E. Install work neatly, with boxes, equipment, etc. plumb and square.
- F. Install the system in cooperation with other trades in order to achieve coordinated progress and satisfactory final results. Watch for conflicts with work of other trades on the job. Execute, without claim for extra payment, moderate moves or changes as are necessary to accommodate other equipment or preserve symmetry and a pleasing appearance.
- G. Install all equipment to provide safe operation.
- H. Provide ventilation as required to maintain equipment within the manufacturer's specified temperature limits.
- I. Field verify all junction box sizes prior to fabricating cover plates. Except where specifically dimensioned, control and connection plate layouts shown on drawings are not scaled. Size plates as necessary to hide joints and gaps between backboxes and surrounding wall.

- J. Where cover plates are not fitted with connectors, provide bushed hole(s) through cover plate in sizes and quantities required. Do not allow cables to enter or exit boxes without cover plates installed.
- K. For all A/V connections provide receptacle plates and panels consistent with architectural specifications. Prior to installation submit to the Architect for approval samples of proposed plates, receptacles, and panels.
- L. Provide steel blank and vent panels on all equipment racks to fill any unused rack spaces, per industry best practices for optimizing airflow. Use panels with factory-applied finishes to match the color of the rack itself unless otherwise directed by the Owner's authorized representative.
- M. Save all unused products accessories and turn over to Owner at checkout.

3.2 PROTECTION AND REPAIR OF EXISTING FINISHES AND STRUCTURES

- A. Cut and patch all holes required for this installation.
- B. Make good all materials and finishes cut into or damaged during installation.
- C. Maintain clean and safe working conditions. Clean the premises where dirtied, and clean all equipment, removing all dirt, dust, stains, and fingerprints. The Contractor is liable for any damage caused by his employees and subcontractors to the property of others.

3.3 DEMONSTRATION AND ACCEPTANCE TESTING

- A. Conduct tests to establish to the satisfaction of the Owner and the Owner's authorized representative that the system performs as required. Before beginning the acceptance testing, have reasonable assurance that such testing shall produce satisfactory results. Conduct testing in the presence of the Owner's authorized representative as well as the Owner, Architect, and General Contractor at their option, at a time mutually agreed to by all parties.
- B. Under the direction of the Owner's authorized representative, conduct tests as outlined below. Furnish any and all equipment and media necessary to perform these tests, and furnish evidence of proper calibration of all test equipment. Provide technical staff (system programmer, DSP programmer) to assist.
 - 1. System Performance Tests. Conduct spot checks of system performance to ensure performance requirements (Paragraph **Error! Reference source not found.** of this Section) are met. Perform such tests as necessary to establish confidence that spot test results are representative of system performance as a whole.
 - 2. Operating Tests. Include tests to verify that system functional requirements (Paragraph **Error! Reference source not found.** of this Section) are met, and that user controls operate properly.

3. Equipment Tests. Confirm the proper functioning of significant equipment items, and confirm required system control over these items.
 4. Final Adjustments. Make control adjustments as directed by the Owner's authorized representative. Provide covers, caps, or shaft-locks for controls not used in system operations. Make a record of these control settings for inclusion with the final documentation.
 5. Listening and Viewing Tests. Include subjective evaluations by persons listening and viewing from various positions under various operating conditions. Conduct such tests to verify system functioning under normal operating conditions.
- C. If the need for adjustment or modification becomes evident during testing, either continue testing, or interrupt testing to permit corrective action, as directed by the Owner's authorized representative. Perform retesting following any corrective action to the extent directed by the Owner's authorized representative.
- D. In addition to Contractor-directed testing, assist as required with specific testing as conducted by the Owner's authorized representative.

END OF SECTION 274116

SECTION 310101

SITE RESTORATION

PART 1 - GENERAL

1.1 QUALITY ASSURANCE

- A. Provide prepackaged seed readily available to the public with quality and purity equal to product of O.M. Scotts and Son, Marysville, OH 43041. On-the-job or made-to-order mixes will not be accepted.
- B. Refer to Specification 32 92 00 Lawns for more information.

1.2 DELIVERY STORAGE AND HANDLING

- A. Deliver fertilizer in manufacturer's standard size bags or cartons showing weight, analysis, and the name of the manufacturer. Store as approved by Director's Representative.
- B. Store all seed at the site in a cool dry place as approved by the Director's Representative. Replace any seed damaged during storage.

1.3 SCHEDULING

- A. Time For Seeding: Optimum period to sow permanent grass seed is generally between April 1st and May 15th or between August 15th and October 1st. Schedule application for when weather conditions permit or as Directed.
 - 1. Provide temporary seed and mulch when final grading is complete while waiting for optimal seeding period.
 - 2. Provide temporary seed and mulch for temporary cover on disturbed ground not to be worked on for more than 7 days.
 - 3. Provide temporary seed and mulch on disturbed earth prior to temporary shutdown of construction.

PART 2 - PRODUCTS

2.1 TOPSOIL

- A. Provide topsoil conforming to the following:
 - 1. Original loam topsoil, well drained homogeneous texture and of uniform grade, without the admixture of subsoil material and entirely free of dense material, hardpan, sod, or any other objectionable foreign material.
 - 2. Containing not less than 4 percent nor more than 20 percent organic matter in that portion of a sample passing a 1/4 inch sieve when determined by the wet combustion method on a sample dried at 105 degrees C.

3. Containing a Ph value within the range of 4.5 to 7 on that portion of the sample that passes a 1/4 inch sieve.
4. Containing the following gradations:

SIEVE DESIGNATION	PERCENT PASSING
1 inch	100
1/4 inch	97 - 100
No. 200	20 - 65 (of the 1/4 inch sieve)

2.2 FERTILIZER

- A. Fertilizer: Mixed commercial fertilizers shall contain total nitrogen, available phosphoric acid and soluble potash in the ratio of 10-6-4 (50% N/UF). 50% of total nitrogen shall be derived from ureaform furnishing a minimum of 3.5% water insoluble nitrogen (3.5% WIN). The balance of the nitrogen shall be present as methylene urea, water-soluble urea, nitrate and ammoniacal compounds.
- B. Other fertilizers meeting DOT Specification Section 713-03 Fertilizer can be used.

2.3 SEED

- A. Furnish fresh, clean, new-crop seed mixed in the proportions specified for species and variety, and conforming to Federal and State Standards.
- B. Acceptable material in a seed mixture other than pure live seed consists of nonviable seed, chaff, hulls, live seed of crop plants and inert matter. The percentage of weed seed shall not exceed 0.1 percent by weight.
- C. All seed will be rejected if the label indicates any noxious weed seeds.
- D. Provide seed mixture per Specification 32 92 00 Lawns.

2.4 MULCH

- A. Hydroseed Application: Do all slurry preparation at the job site:
 1. Water, mulch, fertilizer, binder and other ingredients shall be added to the tank simultaneously so that the finished load is a homogenous mix of the specified ingredients.
 2. Seed shall be added last and shall be discharged within 2 hours. Loads held over 2 hours will be recharged with ½ the seed rate before application.
 3. Once fully loaded, the complete slurry shall be agitated for 3-5 minutes to allow for uniform mixing.
- B. HydroSeeding Application: One Step Hydroseed

Lbs/Ac	Material
2,000 lbs	100% Cellulose or Wood Fiber

80 lbs
16 lbs

Fertilizer (3.04 Fertilizer 10-6-4)
Seed as per section (2.02 Seed)

PART 3 - EXECUTION

3.1 GRADING

- A. Rough Grading: Trim and grade lawn areas within the Contract Limit to a level of 4 inches below the finish grades indicated unless otherwise specified herein or where greater depths are indicated. Provide smooth uniform transition to adjacent areas.
- B. Finish Grading: Finish surfaces free from irregular surface changes, and as follows:
 - 1. Grassed Areas: Finish areas to receive topsoil to within 1 inch above or below the required subgrade surface elevations.

3.2 SPREADING TOPSOIL

- A. Perform topsoil spreading operations only during dry weather.
- B. To insure a proper bond with the topsoil, harrow or otherwise loosen the subgrade to a depth of 3 inches before spreading topsoil.
- C. Spread topsoil directly upon prepared subgrade to a minimum depth measuring 4 inches after natural settlement in areas to be seeded. Smooth out unsightly variations, bumps, ridges, and depressions that will hold water. Remove stones, litter, or other objectionable material. Finished surfaces shall conform to the contour lines and elevations indicated on the drawings or fixed by the Director's Representative.

3.3 PREPARATION FOR SEEDING

- A. Seed Bed: Scarify soil to a depth of 2 inches in compacted areas. Smooth out unsightly variations, bumps, ridges, and depressions that will hold water. Remove stones, litter, or other objectionable material.

3.4 FERTILIZING

- A. Apply 10-6-4 fertilizer evenly at the rate of 40 pounds per 1000 sq ft.

3.5 SEEDING

- A. Assume all risks when seed is sowed before approval of seed analysis.
- B. Do not seed when the wind velocity exceeds 5 miles per hour.
- C. Application Rate: 8 pounds per 1000 sq ft.

- D. Dry Application: Sow seed evenly by hand or seed spreader on dry or moderately dry soil.
- E. Wet Application: Refer to Hydroseeding Application.

3.6 MULCHING

- A. Dry Application: Within 3 days after seeding, cover the seeded areas with a uniform blanket of straw mulch at the rate of 50 pounds per 1000 sq ft of seeded area.
- B. Wet Application: All hydroseed applications are to be applied in a sweeping motion to form a uniform application and form a mat at the specified rates.
 - 1. Unused Loads: If mixture remains in tank for more than 8 hours it shall be removed from the job site at contractor's expense.
 - 2. Reseeding: After "Final Acceptance", reseeding will be done at the request of the owner and shall be considered extra.

3.7 LAWN ESTABLISHMENT

- A. Maintain the grass at heights between 2-1/2 inches and 3-1/2 inches and include a minimum of 2 mowings.
- B. Water and protect all seeded areas until final acceptance of the lawn.

3.8 IRRIGATION SYSTEM MODIFICATIONS

- A. Adjust irrigation system sprays and rotors within lawn areas to provide full head to head coverage.
- B. Replace spray and rotor heads removed during demolition phase with in-kind make/model and nozzle type.

3.9 FINAL ACCEPTANCE

- A. Final acceptance of seeded areas will be granted when a uniform stand of acceptable grass is obtained, with a minimum of 95 percent coverage. Portions of the seeded areas may be accepted at various times at the discretion of the Director's Representative.
- B. Unacceptable seeded areas, dry application: Reseed as specified and fertilized at one-half the specified rate.
- C. Once accepted, the State will assume all maintenance responsibilities.

END OF SECTION 310101

SECTION 311100

CLEARING AND GRUBBING

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. The Contractor shall do all required clearing and grubbing as indicated on the drawings or herein specified in the area required for construction operations on the Owner's land or in the Owner's permanent or temporary easements and shall remove all debris resulting therefrom.
- B. Unless otherwise noted, all areas to be cleared shall also be grubbed.
- C. The Contractor shall not clear and grub outside of the area required for construction operations.

1.2 RELATED WORK:

Any trees and shrubs specifically designated by the Owner not to be cut, removed, destroyed, or trimmed shall be saved from harm and injury in accordance with Section 01 57 19, ENVIRONMENTAL PROTECTION.

PART 2 - PRODUCTS: NOT APPLICABLE

PART 3 - EXECUTION

3.1 RIGHT TO WOOD AND LOGS:

The Owner shall have the right to cut and remove logs and other wood of value in advance of the Contractor's operations. All remaining logs and other wood to be removed in the course of clearing shall become the property of the Contractor.

3.2 CLEARING:

- A. Unless otherwise indicated, the Contractor shall cut or otherwise remove all trees, saplings, brush and vines, windfalls, logs and trees lying on the ground, dead trees and stubs more than 1-foot high above the ground surface (but not their stumps), trees which have been partially uprooted by natural or other causes (including their stumps), and other vegetable matter such as shags, sawdust, bark, refuse, and similar materials.
- B. The Contractor shall not remove mature trees (4-inches or greater DBH) in the Owner's temporary easements.
- C. Except where clearing is done by uprooting with machinery or where stumps are left longer to facilitate subsequent grubbing operations, trees, stumps, and stubs to be cleared shall be cut as close to the ground as practicable but not more than 6-inches above the

ground surface in the case of small trees, and 12-inches in the case of large trees. Saplings, brush and vines shall be cut close to the ground.

3.3 GRUBBING:

- A. Unless otherwise indicated, the Contractor shall completely remove all stumps and roots to a depth of 18-inches, or if the Contractor elects to grind the stumps, they shall be ground to a minimum depth of 6-inches.
- B. Any depression remaining from the removal of a stump and not filled in by backfilling shall be filled with gravel borrow and/or loam, whichever is appropriate to the proposed ground surface.

3.4 DISPOSAL:

All material collected in the course of the clearing and grubbing, which is not to remain, shall be disposed of in a satisfactory manner away from the site or as otherwise approved. Such disposal shall be carried on as promptly as possible and shall not be left until the final clean-up period.

END OF SECTION 311100

SECTION 311111

SITE DEMOLITION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY OF WORK

- A. Specifically included without limiting the generality of drawings and specifications are:
 - 1. Selective Demolition for site work. Refer to architectural/ structural demolition as described elsewhere in specifications.

1.3 SELECTIVE DEMOLITION

- A. Removal of all existing components and construction where shown, implied, and/or required to execute the reconstruction.
- B. Removal and storage on site of all items/materials which at the Owner's direction, are to remain property of the Owner. All other items/materials are to be deemed demolition refuse.
- C. Removal of all abandoned services and utilities within the work area.
- D. Remove and legally dispose of all demolition refuse from the Project Site.
- E. Protect from damage existing finish work that is to remain in place and becomes exposed during demolition operations.
- F. Protection of all existing services and utilities which are to remain functioning and in use during the construction period. Provide temporary services as required until all new systems are operational.
- G. Disconnect and remove all project abandoned, or previously abandoned utility service connectors in accordance with regulations of authorities concerned.
- H. Demolition and complete removal of existing system(s) unless otherwise noted.
- I. Conduct demolition operations and removal of debris 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 the Owner. Provide alternate routes around closed or obstructed traffic ways as required by the Owner.
- J. Protect all site utilities at demolition work and placement of new work.
- K. Bury NO demolition refuse on Site.

1.4 CONTROL DEVICES

- A. Furnish and install construction fencing, dust and noise control barriers, etc. as required. Conduct selective demolition work in manner that will minimize need for disruption of Adjacent Neighbor's normal operations. Provide minimum of 72 hours advance notice to Owner of demolition activities that will impact Owner's use of site.
 - 1. Provide temporary sheeting, shoring, bracing as required to protect and support adjacent elements which remain.

PART 2 - PRODUCTS (Not used)

PART 3 - EXECUTION

3.1 EXECUTION OF THE WORK

- A. Perform all work in strict accordance with all applicable Codes, Laws, and Ordinances having jurisdiction over the Work and specifically in accordance with the following to the extent that such provisions are not in conflict with applicable local laws.
 - 1. NYS Workmen's Compensation Law.
 - 2. Rules of the Workmen's Compensation Board of the State of New York.
 - 3. Manual of Accident Prevention in Construction, published by the Associated General Contractors of America, Inc.
 - 4. New York State Uniform Fire Prevention and Building Code.
 - 5. Industrial Code Rule 23, Protection of Persons Employed in Construction and Demolition Work, State of New York, Department of Labor.
 - 6. New York State Labor Law.
- B. Submit a coordination Schedule for Shut-off, capping, removal, and continuation of any utility services.
 - 1. Protection of Persons and traffic.
 - a. Ensure safe passage of pedestrians and vehicular traffic around areas of removal.
 - b. Conduct operations in a manner to prevent injury to persons or property.
 - c. Erect temporary passageways as required or directed by authorities having jurisdiction.
 - 2. Avoid overloading portions of the existing structure with demolition debris, new materials, and/or equipment.
 - 3. All materials resulting from the removal operation shall become the property of the Contractor except that identified or required to remain the property of the Owner.
 - 4. All salvage and debris resulting from the demolition operations shall be immediately removed from the site and shall not be stored or permitted to accumulate or be sold at the site.
 - 5. The Contractor shall comply with the applicable laws and ordinances governing the disposal of materials, debris, rubbish and trash off the project site, and shall commit no trespass on public or private property in any operation hereto or connected with this Contract.
 - 6. No burning shall be permitted on the Project Site.

7. All uncharted conduits, mains, lines, etc. encountered in the project shall be taken care of properly and safely by the Contractor, who upon encountering them, shall notify the Owner of the findings and arrangements made for modification necessary as not to interfere with the work.
8. Promptly repair damages caused to adjacent facilities by demolition work at no cost to Owner.

3.2 DUST CONTROL

- A. The Contractor shall be responsible for providing all the necessary precautions and measures to prevent and control the spread of dust during all phases of this project. These measures shall be implemented as required and as required by the Architect/Engineer throughout construction.

3.3 NOISE CONTROL

- A. All operations shall be conducted as quietly as reasonably possible.
- B. Personnel shall be instructed to avoid unnecessary noise and reminder signs shall be posted conspicuously.
- C. Before starting any work that involves unavoidable noise, the Contractor shall notify the Architect/Engineer and Owner in writing sufficiently in advance to allow for special preparation, if any are possible.
- D. Whenever persons are subjected to sound exceeding those listed on OSHA Standards table; feasible administrative or engineering controls shall be utilized.
- E. Sound levels shall be measured on the A-scale of a standard sound level meter at low response. Genuine loss of hearing can result if a person is repeatedly exposed to levels greater than 85-90 dba during the workday.

3.4 CLEANUP

- A. On completion of the work, the Contractor shall remove all temporary construction no longer needed, equipment, salvaged materials, trash and debris of all kinds and shall leave the area in a finished condition.

END OF SECTION 311111

SECTION 311313

TREE PRUNING AND TREE AND STUMP REMOVALS

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. The work of this Section includes the following:
 - 1. Removal of trees and stumps.
- B. Refer to the Contract Drawings for general location of trees along the site perimeter. In general, all trees are to remain and be pruned in conformance with this Specification. Tree removals shall be limited to the area denoted on the plans and shall include the removal of individual trees that would impede the construction of proposed facilities.

1.2 QUALIFICATIONS OF CONTRACTOR:

- A. This work shall be limited to individuals, partnerships and corporations who are actively engaged in the field of Arboriculture, and who demonstrate competence, experience and financial capability to carry out the terms of this project. The Owner may require proof of these qualifications.
- B. All work shall be conducted by qualified and trained personnel under the direct supervision of an **ISA** Certified Arborist (**International Society of Arboriculture**) in the Contractor's employ.

1.3 PERSONNEL:

- A. The Contractor shall submit each employee's name and title prior to the commencement of work. The Contractor shall advise the Owner of any changes in personnel assigned to this Contract.
- B. The crew foreman shall have a minimum of five (5) years climbing/pruning experience. At least one (1) crew person shall be an **ISA certified arborist** and shall be certified in CPR.
- C. Each trimmer shall be experienced and highly qualified with the necessary tree worker skills to successfully complete the work of this Section, including the ability and training to perform aerial rescue. Said skill shall also include worker safety and ability in compliance with current OSHA and ANSI Z-133.1 Standards.

1.4 SPECIAL REQUIREMENTS:

- A. No burning shall be permitted on the project site.

- B. Prior to commencing work, the Contractor shall submit a plan to the Owner for legal disposal of removed materials, in conformance with State and Federal regulations.

1.5 STANDARDS AND DEFINITIONS:

- A. All pruning work shall be performed in accordance with the following:
 - 1. The ANSI A300 'Standard Practices for Trees, Shrubs, and Other Wood Plant Materials' of the Secretariat: National Arborist Association, Post Office Box 1094, Amherst, New Hampshire 03031.
 - 2. American National Standards Institute (ANSI) Standard Z-133.1.
 - 3. The standards and practices of the International Society of Arborists.
 - 4. The standards and practices of the American Association of Nurserymen.
- B. The term 'Owner' shall mean the Owner's designated representative charged with carrying out the requirements of this Project, Architect, Engineer, Planner, or Tree Warden as referenced herein, rendering approvals for the Owner.

1.6 EXAMINATION OF SITE AND DOCUMENTS:

- A. The Contractor shall be responsible for having a clear understanding of the existing site conditions and shall be responsible for fully carrying out the work of this Section, regardless of actual site conditions encountered.

1.7 ORDER OF WORK:

- A. Based on the site conference, the Contractor shall submit a schedule of work for the Owner's review and approval prior to beginning work. Unless otherwise authorized by the Owner, failure of the Contractor to comply with the approved removal schedule shall be sufficient cause to give notice that the Contractor is in default of the contract.

1.8 PROTECTION OF THE VEGETATION TO BE PRESERVED:

- A. The Contractor shall protect all existing trees, shrubs, lawns and other site features designated to remain. The placement of protection devices, such as snow fence enclosures, shall, however, be at the Contractor's discretion.
- B. Damage no plant to remain by burning, pumping water, cutting of live roots or branches, or any other means. Neither vehicles nor equipment shall be parked within the dripline of trees to remain, or where ever damage may result to trees to be saved. Construction material shall not be stored beneath trees to be saved.
- C. The Contractor shall be liable for any damage to any trees, shrub, lawn or other site features to remain, and shall immediately report to the Owner. Damaged shrubs or

lawns shall be restored or replaced to match existing to remain to the satisfaction of the Owner.

- D. The Contractor shall compensate the Owner for damages by installing replacement tree(s) of the size and species approved by the Owner and of sufficient quantity such that the sum of the Diameter at Breast Height (DBH) inches for replacement trees equals the total DBH inches of the damaged tree(s). Damaged shrubs shall be replaced with shrubs(s) of the same size, species, and quantity, unless determined otherwise by the Owner.

1.9 USE AND CARE OF THE SITE:

- A. The Contractor shall leave the work site at the end of each working period in a condition satisfactory to the Owner.
- B. Pavements shall be swept and lawns or other surfaces raked and/or otherwise cleaned of all material related to the work operation. Degree of clean-up required will be described by the Owner and will be based upon the character of the work area.
- C. All trimmings or any other form of debris (except diseased materials or trimmings from Elms) shall be collected and chipped. The Contractor shall remove all materials and shall dispose of such materials off site in a legal manner.
- D. No vehicles are to be stored on site. The Contractor shall be fully and solely responsible for any damage to equipment or vehicles left at the site of the work. All necessary permits shall be obtained by the Contractor.

PART 2 - PRODUCTS

2.1 EQUIPMENT:

- A. Equipment necessary for this Contract shall be properly maintained and in good operating condition to the City's satisfaction. The Contractor shall promptly remove and replace any equipment which the Owner deems to be in unsatisfactory condition or otherwise unsuitable.
- B. Cutting tools shall be kept well sharpened to provide clean smooth cuts. Any tools utilized on any tree suspected to have cankers or other fungal, bacterial or viral diseases shall be sterilized or not used on any other specimen.
- C. A disc chipper shall be used which will process material up to twelve (12) inches in diameter.

PART 3 - EXECUTION

3.1 PRUNING:

- A. Under this Section, the Contractor shall furnish all labor, materials, equipment and transportation required to complete all aspects of the work in accordance with all local, state and federal regulations in force at the same time of this Contract and in

accordance with tree pruning as specified herein.

- B. The work of this Section consists of all pruning work and related items as specified herein and includes, but is not limited to:
 - 1. Pruning - Class II throughout the designated areas and limb removal required to allow for the proper installation of all fields, play equipment and new fencing.

Class II pruning is defined as medium pruning and shall consist of the removal of dead, dying, diseased, interfering, objectionable and weak branches on the main trunks as well as those within the leaf area. An occasional branch one (1) inch or less in diameter may remain within the main leaf area where it is not practical to remove it.

3.2 DESCRIPTION OF PRUNING WORK:

- A. Pruning and trimming are generally described as the removal and disposal of limbs, branches and stubs which are either dead, potentially detrimental to the health of the tree or dangerous to pedestrians, visually deficient, interfering or otherwise objectionable as determined by the Owner.
- B. The limits of all trees to be pruned have been identified on the plans or referenced elsewhere in this specification section.
- C. Vehicle access shall be controlled and approved by the Owner.
- D. If the Contractor discovers tree(s) which have not been marked for pruning, but whose condition is such that removal is warranted, whether due to death, disease, decay, or structural weakness, such tree(s) shall not be pruned and the Contractor shall immediately report these findings in writing to the Owner and await the Owner's direction before proceeding with work on the particular tree(s) in question.
- E. All pruning shall be performed in a manner that maintains the natural aesthetic characteristics of the species and variety of trees. No topping or dehorning of trees or stubbing back of branches shall be permitted. All cuts shall be made to a lateral branch that is a minimum of one third (1/3) the size of the branch being removed, unless otherwise instructed by the Owner.
- F. The use of climbing spurs or spiked shoes shall not be permitted and their use will result in the immediate cancellation of the contract.
- G. All cuts shall be made sufficiently close to the parent stem so that wound closure can be readily started under normal conditions. Cuts shall, however, never be made through the branch collar. Slab cuts and rip cuts will result in cancellation of the contract.
- H. All limbs over two (2) inches in diameter to be removed shall be precut to prevent splitting. Any branches that by falling would injure existing trees to remain or other objects shall be lowered to the ground by proper ropes.

- I. On trees known to be diseased and where there is known to be danger of transmitting the disease on tools, tools shall be disinfected with alcohol or bleach after each cut between trees.
- J. Lateral branches as well as occasional branch suckers ("water sprouts") may be retained. Complete removal of secondary laterals and branch suckers resulting in the stripping of major limbs, ("lion tailing") will not be permitted.
- K. Tree paint to seal pruning cuts shall not be used.
- L. All branches and limbs shall be manually lowered to the ground via rope and pulley. This practice must be consistent with the National Arborist Association Standards for Pruning. All grade-level artifacts and landscaping must be protected from damage.

3.3 REMOVALS:

- A. The Contractor shall furnish all labor, materials, equipment and transportation required to complete all aspects of the removals work in accordance with all local, state, and federal regulations in force at the time of this contract and in accordance with tree and stump removals as specified herein.

3.4 DESCRIPTION OF REMOVAL WORK:

- A. Removal is generally described as the removal of groups and individual trees and shrubs which interfere with the growth of more desirable types of trees; the clearing away of lesser growth that may obscure outstanding trees; and thinning out to provide space for healthy growth by the elimination of thinner, weaker trees.
- B. The Contractor shall adhere to the specifications and provide suitable facilities for inspecting the work. Failure of the Owner to immediately reject unsatisfactory work or to notify the Contractor of deviations from the specification shall not relieve the Contractor of responsibility to correct or remedy unsatisfactory work.
- C. The Contractor shall only work on trees designated by the Owner. No compensation will be made for work performed on any other tree or trees.
- D. Trees designated to be removed shall be taken down and all leaves, branches and trunks of trees properly disposed of by chipping and removal from the premises.
- E. Fell trees in a manner that allows all site features and those trees to be saved undamaged.
- F. Removal of all the parts of each tree shall be completed on the same day that the tree is cut.
- G. Stumps shall be ground to eighteen (18) inches below grade by grinding or other means acceptable to the Owner. The void from the stump removal operations shall be filled with ordinary borrow soil to within six (6) inches of finished grade. The top six (6) inches shall be filled with screened loam, moderately tamped to prevent future settling. In grass areas the disturbed area shall be sown with grass seed of a

mix appropriate to the location, as required by the Owner.

- H. Excavation or grading within the branch spread of trees to be saved shall be performed as required by the Owner. Removal of pavement such as bituminous concrete in these zones shall be by hand tools and/or air spade to ensure root health for trees to remain.
- I. All equipment to be used and all work to be performed must be in full compliance with all standards as promulgated by OSHA at the time of bidding, including but not limited to those regulations concerning noise levels, protective devices and operator safety.
- J. The Contractor shall be solely responsible for pedestrian and vehicular safety and control within the work site and shall protect the public and its property from injury or damage that could be caused by the progress of the work. To this end the Contractor shall provide, erect, and maintain protective devices acceptable to the Owner, including but not limited to barricades, lights and warning signs.
- K. Any practice employed by the Contractor that is obviously hazardous as determined by the Owner shall be immediately discontinued by the Contractor upon receipt of either written or oral notice from the Owner to discontinue such practice.

END OF SECTION 311313

SECTION 312213

ROUGH GRADING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

A. Cutting, filling and compacting to establish subgrade for:

1. Pavements.
2. Lawns and landscape areas.

B. Compaction of embankments.

C. Disposal of unsuitable material.

D. Disposal of excess material.

E. Install grade stakes at 50-ft o.c. (or less) grid pattern to ensure all grades comply with allowable tolerances. This is true for subgrades and finished grades.

1.3 RELATED SECTIONS

Section 02 30 00: Soil Testing Services.

Section 31 23 00: Earthwork.

Section 31 23 16: Trenching, Backfilling and Compaction.

Section 32 10 00: Roadway and Miscellaneous Subbase.

Section 32 91 13: Soil Preparation and Soil Mixes.

Section 32 92 00: Lawns.

Section 33 40 00: Storm Sewer Systems.

1.4 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies.

1. Comply with requirements of:
 - a. OSHA.
 - b. New York State Department of Labor.
 - c. U.S. Army Corps of Engineers
 - d. Other agencies with jurisdiction.
2. Obtain all permits required for the completion of the project.

B. Testing Laboratory Requirements:

1. Obtain a testing laboratory to perform soil testing and inspection for quality control during rough grading operations.
2. Before commencing work, obtain approval from Owner and Landscape

Architect/Engineer of:

- a. Testing laboratory.
- b. Testing schedule.

C. Reference Standards:

1. NYSDOT Specs.
2. ASTM.

D. Allowable Tolerances:

1. Subgrades for areas other than roadways and miscellaneous surfaces should be:
 - a. Graded parallel to finished grade.
 - b. Within one inch of required grade.
 - c. Without depressions which hold water.

1.5 SUBMITTALS

A. Test Requirements:

1. Testing laboratory.
2. Testing schedule.
3. Gradation test reports: For all materials specified in this section.
4. Optimum moisture and maximum density:
 - a. Structural Fill.
 - b. Native, on-site general fill.
5. Field density test reports.

B. Manufacturer's Data:

1. Geotextile.
2. Compaction equipment.
3. All Products.

1.6 PROJECT CONDITIONS

A. Notify:

1. UFPO at 1-800-962-7962 not less than 72 hours prior to starting rough grading for location of underground utilities such as gas, telephone, electric lines, etc.
2. Other private and public utilities in the work area.
3. Landscape Architect/ Engineer and Construction Manager.
 - a. At least 24 hours prior to commencing rough grading.
 - b. When rough grading has established final subgrade elevations.
 - c. When unsuitable material is encountered at required subgrades.
 - d. When unauthorized excavations have taken place.

- e. When rock is encountered.
- f. When suitable subgrades become unsuitable due to lack of dewatering.
- g. When uncharted, unidentified, incorrectly charted or incorrectly located underground utilities are encountered.

B. Existing Conditions:

- 1. Data regarding subsurface conditions are not intended as representations or warranties of accuracy or continuity between soil borings and test pits. It is expressly understood that the Owner or Landscape Architect/ Engineer will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data are made available for convenience of Contractor.
- 2. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.
- 3. Do not interrupt existing utilities servicing facilities occupied and used by Owner and others except when permitted in writing, and then only after acceptable temporary utility services have been provided, or permission to interrupt service is granted by utility authority. Provide minimum of 48 hour notice to utility company, and receive written notice to proceed before interrupting any utility.

C. Environmental Conditions:

- 1. Do not commence rough grading if ground is frozen, muddy or covered with snow.
- 2. Do not commence or continue rough grading when precipitation is falling.
- 3. Protect established subgrades against freezing when atmospheric temperature is less than 35° F.
- 4. Do not place embankment on frozen subgrade.

1.7 SEQUENCING AND SCHEDULING

A. Do not commence rough grading until:

- 1. Site preparation is complete within the Contract Limit Line.
- 2. Site preparation is complete within substantial portions of the Project as approved by the Landscape Architect/ Engineer.
- 3. Adequate grade stakes have been established to guide work as required by the Landscape Architect/ Engineer.
- 4. All protective measures are in place.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Select Fill: Conforming to DOT Specs, Item 203.06 specified in Section 203-2.02B, sound, durable sand, gravel, stone or blends of these materials, free from organic material, other deleterious material and frozen sections. Material furnished shall have the following gradation:

<u>SIEVE SIZE</u>	<u>PERCENT PASSING BY WEIGHT</u>
-------------------	----------------------------------

4 inch	100
No. 40	0 - 70
No. 200	0 - 15

Fines passing No. 200 shall be non-plastic.

- B. Select Granular Subgrade: Conforming to DOT Specs, Item 203.20, specified in Section 203.2.02E.

1. Well-graded rock may be used. Particles should not exceed 12 inches in greatest dimension nor 2/3 of the loose lift thickness, whichever is less.
2. All materials, other than well graded rock, furnished under this item shall have no particles greater than 6 inches in maximum dimension. Of the portion passing the 4 inch square sieve, the material shall have the following gradation:

<u>SIEVE SIZE</u>	<u>PERCENT PASSING BY WEIGHT</u>
-------------------	----------------------------------

1/4 inch	30 - 100
No. 40	0 - 50
No. 200	0 - 10

Where the Owner elects to test for this requirement, a material with a Magnesium Sulfate Soundness Loss exceeding 35 percent will be rejected.

3. Materials should be free from organic materials, other deleterious material and frozen sections.
- C. Native Material: Subsoils found at the site may be used as fill that will not support structures, roadways, artificial turf field or miscellaneous surfaces, as approved by Engineer.
1. Saturated native materials should be stockpiled in windrows to dry.
 2. Use native materials in embankments only after optimum moisture content has been reached.
 3. Material should be free from organic materials, other deleterious materials and frozen sections.
- D. Geotextile: Woven, polypropylene reinforcement fabric.
1. Amoco 2006 or,
 2. Mirafi 500 X or,
 3. Approved equivalent.
 4. Or as indicated on the plans.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities on and adjacent to Owner's property from damage caused by settlement, lateral movement, undermining, washout and other hazards created by rough grading operations.
- B. Protect survey markers on and adjacent to Owner's property including but not limited to iron pipes and rods, concrete and stone monuments, hubs, stakes, etc.
- C. The following are prohibited within the drip line of all vegetation to remain:
 - 1. Stockpiling construction materials, including soil.
 - 2. Vehicular traffic.
 - 3. Parking of any vehicle or equipment.
 - 4. Discharging solid or liquid waste.
 - 5. Servicing vehicles, machinery or equipment.
 - 6. Placing shanties, sheds and other temporary enclosures.
- D. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if lines are active. Comply with regulations and requirements of utility authority. (Provide temporary means of conveyance for all disturbed utilities as required until such a time the new systems are operational).
- E. Bench existing slopes where embankments are to be placed on slopes steeper than 1 (vertical) on 5 (horizontal).
 - 1. Bottom of bench: Sloped at approximately 2 percent, draining downhill, without depressions.
 - 2. Sideslope of bench: At a stable angle of repose suitable to sustain itself until placement of embankment material.
 - 3. Place embankment material as soon as each bench is complete.

3.2 INSPECTION

- A. Examine the site to verify:
 - 1. All protective measures are in place.
 - 2. Field stake-out has been completed.

3.3 SPECIAL PRECAUTIONS

- A. The use of explosives is not permitted. Do not bring explosives onto the site or use in the work of this Contract.
- B. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner. Report findings to Landscape Architect and/or Engineer.
- C. Perform excavation within drip line of trees to remain by hand, and protect the root system from damage or dry out.

- D. Protect newly graded areas from traffic and erosion, and keep them free of trash and debris until completion of the work of this Contract.
- E. Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace in accordance with applicable laws and codes where sloping is not possible because of space restrictions or stability of material excavated.
- F. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
- G. The Contractor is responsible for all means of erosion control during all phases of construction, at his expense. Any damage due to erosion conditions shall be repaired by the Contractor at no cost to the Owner and to the satisfaction of the Landscape Architect/ Engineer.

3.4 HANDLING MATERIALS

- A. The moisture content of a material may be such that its use will require extensive manipulation. It is the Contractor's responsibility to determine the economics of using, or disposing and replacing such materials. Material determined by the Contractor to be uneconomic for use may be disposed of as specified and replaced with other material at no additional cost to the Owner.
- B. Stockpile satisfactory excavated materials until required for backfill or fill. Place, grade and shape stockpiles for proper drainage and drying. Protect from contamination.
- C. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.
- D. Where subgrade or lifts of soil material must be moisture conditioned before compaction, uniformly apply water to surface or subgrade, or lifts of soil material, to prevent free water appearing on surface during or subsequent to compaction operations.
- E. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density.
- F. All excavated unsuitable and excess materials are the Contractor's responsibility for disposal at an off-site location in a legal manner.

3.5 ROUGH GRADING

- A. Establish required subgrades by cutting, filling and compacting.
 - 1. Subgrades should conform to cross sections, elevations and grades of finished grades with allowances for depth of finish improvements. Subgrades shall comply with allowable tolerances. Failure to do so shall be at the contractor's risk and cost.

3.6 GRADING BELOW REQUIRED SUBGRADES

- A. Fill all unauthorized excavation in subgrade areas with compacted select granular subgrade material without altering required subgrade elevations.
 - 1. Concrete fill may be used to bring subgrades to required elevations only

- when approved in writing by the Landscape Architect/ Engineer.
2. Notify Landscape Architect/Engineer of unauthorized excavation before commencing remedial work.
- B. Unauthorized excavation in lawn and landscape areas may be filled with the material otherwise specified for placement on subgrade at no additional cost to the Owner.
- C. If unsuitable bearing materials are encountered at required subgrade elevations, notify the Owner and Landscape Architect/ Engineer and proceed with the following operations at no additional cost to the owner.
1. Carry excavations deeper until suitable bearing material is encountered or as required.
 2. Remove unsuitable material and dispose of in a lawful manner.
 3. Place geofabric on undercut subgrade.
 4. Place select granular subgrade material and compact in lifts to required subgrade elevations.
- D. If established subgrades on suitable material become unsuitable because of saturation due to Contractor's failure to provide de-watering, or other construction operations, proceed with the operations specified in the preceding paragraph at no additional cost to the Owner.

3.7 ROCK

- A. Where footings, foundations or other work requiring soil support rest entirely on rock, remove all loose soil and rock at required subgrade elevations.
- B. Where footings, foundations or other work requiring soil support rest partially on rock and partially on soil, notify the Landscape Architect/ Engineer immediately, before backfilling or placing other work.

3.8 DEWATERING

- A. Prevent surface water and subsurface or 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 at no additional cost to the Owner.
- C. Establish and maintain temporary drainage ditches and other diversions outside grading limits to convey rain water and water removed from excavations to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.
- D. The Contractor is responsible for providing all the necessary means of dewatering for the duration of the project. Areas damaged due to improper dewatering methods shall be repaired at no cost to the Owner to the satisfaction of the

3.9 FILLING AND COMPACTING

- A. Place geofabric on subgrade according to manufacturer's instructions so it lays flat without creases, folds, or other irregularities. Minimum overlap at joints: 18 inches.
- B. Place embankment materials in lifts not exceeding 12 inches in loose depth according to DOT Specs, Section 203-3.10.
 - 1. Stumps, logs and other decomposable materials are not to be used in any part of embankments.
- C. Compact each lift of embankment material as specified in DOT Specs, Section 203-3.12.
 - 1. In all areas other than those supporting lawns and landscape areas: to at least 95% of Modified Proctor Maximum Dry Density.
 - 2. In all lawn and landscape areas: to a minimum of 85% and maximum of 90% of Modified Proctor Maximum Density.
 - 3. In detention basin fill areas: to a minimum of 80% and maximum of 85% for the basin bottom and at least 95% of Modified Proctor Maximum Density for weir or berm (earth containment) areas.

3.10 PROOF ROLLING

- A. Immediately prior to final trimming of the subgrade and placement of subbase materials for roadways and miscellaneous surfaces, all areas of the subgrade should be proof rolled.
 - 1. On embankments conforming to DOT Specs, Section 203-3.13.
 - 2. In cut sections conforming to DOT Specs, Section 203-3.14.
- B. If proof rolling reveals unsatisfactory bearing conditions:
 - 1. In cut sections: proceed according to paragraph 3.6 C of this specification as directed.
 - 2. On embankments: proceed according to paragraph 3.6 D of this specification as required, at no additional cost to the Owner.

3.11 REMEDIAL ACTION

- A. If field density reports or inspection by the Owner or Landscape Architect/ Engineer reveal that subgrades or embankments have been constructed below specified density, provide additional compaction and testing at no additional cost to the Owner until specified densities are achieved.
- B. Repair and re-establish grades in settled, eroded and rutted areas to specified tolerance.
- C. Where completed, compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density prior to further construction.

- D. Where settling is measurable or observable during general project warranty period, remove surface (pavement, lawn or other finish), add originally specified material, substituting select granular subgrade material for native material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.
- E. Subgrade areas which do not comply with the allowable tolerances set forth in these specifications. Shall be reestablished to such tolerances and approved by the Landscape Architect/ Engineer for substantial compliance.

END OF SECTION 312213

SECTION 312300
EARTHWORK

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Work Included:

- 1. Excavation, backfill, grading, and compaction relating to all phases of construction.
 - 2. Importing and exporting material fill as required to meet final grades.

- B. Related Sections include the following:

- Section 02 30 00: Soil Testing Services.
 - Section 31 11 00: Clearing and Grubbing.
 - Section 31 22 13: Rough Grading.
 - Section 31 23 16: Trenching, Backfilling & Compaction.
 - Section 32 12 16: Asphalt Concrete Paving, Surfacing and Striping.
 - Section 32 91 13: Soil Preparation and Soil Mixes.
 - Section 32 92 00: Lawns.

1.3 UNIT PRICES

- A. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following:
 - 1. 24 inches outside of concrete forms other than at footings.
 - 2. 12 inches outside of concrete forms at footings.
 - 3. 6 inches outside of minimum required dimensions of concrete cast against grade.
 - 4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
 - 5. 6 inches beneath bottom of concrete slabs on grade.
 - 6. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.
- B. Unit prices for rock excavation include replacement with approved materials.
- C. Unit prices for unsatisfactory soils include excavation of soils and replacement with approved materials.

1.4 DEFINITIONS

- A. Backfill: Soil materials used to fill an excavation.
 - 1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
 - 2. Final Backfill: Backfill placed over initial backfill to fill a trench.

- B. Base Course: Layer placed between the subbase course and asphalt paving.
- C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations.
 - 1. Additional Excavation: Excavation below subgrade elevations as required by the Landscape Architect. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
 - 2. Bulk Excavation: Excavations more than 10 feet in width and pits more than 30 feet in either length or width.
 - 3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without a request by the Landscape Architect. Unauthorized excavation, as well as remedial work required by the Landscape Architect, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material exceeding 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, or blasting, when permitted:
 - 1. Excavation of Footings, Trenches, Pits and Bulk Excavations: Late-model, track-mounted hydraulic excavator; equipped with a 42 inch-wide, short-tip-radius rock bucket; rated at not less than 120-hp flywheel power with bucket-curling force of not less than 25,000 lbf and stick-crowd force of not less than 18,700 lbf; measured according to SAEJ-1179.
 - 2. If the material can be removed by ripping, plowing or excavating equipment from any direction, the material shall not be classified as rock.
- I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- J. Subbase Course: Layer placed between the subgrade and base course for asphalt paving, or layer placed between the subgrade and a concrete pavement or walk.
- K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- L. Utilities on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

- M. Unsatisfactory soil: Soil which in the opinion of the Engineer is incapable after compaction of properly supporting the utility pipe or structure. The ability of soils listed in paragraph 2.1 C to provide proper support will be based upon field conditions.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Drainage fabric.
 - 2. Separation fabric.
 - 3. All Products.
- B. Samples: For the following:
 - 1. Soil gradation results for each proposed soil material.
 - 2. 12-by-12-inch sample of drainage fabric.
 - 3. 12-by-12-inch sample of separation fabric.
- C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
 - 1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
 - 2. Laboratory compaction curve according to ASTM D 698 for each on-site or borrow soil material proposed for fill and backfill.
 - 3. Laboratory compaction curve according to ASTM D 1557 for each on-site or borrow soil material proposed for fill and backfill.

1.6 QUALITY ASSURANCE

- A. Comply with latest requirements of:
 - 1. OSHA.
 - 2. NYS Department of Labor.
 - 3. NYS Department of Transportation
 - 4. NYS Department of Environmental Conservation.
 - 5. Other agencies with jurisdiction.

1.7 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Landscape Architect/ Engineer and then only after arranging to provide temporary utility services according to requirements indicated:
 - 1. Notify Landscape Architect/ Engineer not less than two days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Landscape Architect /Engineer written permission.
 - 3. Contact utility-locator service for area where Project is located before excavating.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations. (Geotechnical Report referenced material).
- B. Satisfactory Soils: ASTM D 2487 in classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
- C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.
 - 1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Backfill and Fill: Satisfactory soil materials in accordance with Geotechnical Report.
- E. Backfill and Fill Material for Utility Trenches Outside of Building (use under paving): Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; meeting gradation of NYSDOT Section 304, Type 4.
- F. Subbase (use under pavement, walks and running track components where applicable.): Material shall consist solely of approved blast furnace slag or of stone which is the product of crushing ledge rock; meeting gradation of NYSDOT Section 304.13, Type 2. (Crusher Run) depth as indicated on plans.
- G. Structural Fill: Artificially graded mixture of crushed stone meeting gradation of NYSDOT Section 304, Type 4, and in accordance with Geotechnical Report.
- H. Pipe Bedding and Pipe Zone Backfill Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone or slag, meeting gradation of NYSDOT Section 703, Table 703-4 Type 1 or 1A, as indicated.
- I. Drainage Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; meeting gradation of NYSDOT Section 304, Type 4 (where applicable.)
- J. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state. (Shall be approved by Landscape Architect/ Engineer).

2.2 ACCESSORIES

- A. Filter Fabric: (Separation Fabric) Manufacturer's standard nonwoven geotextile fabric of polypropylene, nylon or polyester fibers, or a combination, with the following properties: Amoco 4545 or equivalent:
 - 1. Grab Tensile: 90 lbs., ASTM D 4632.
 - 2. Grab Elongation: 50%, ASTM D 4632.
 - 3. Mullen Burst: 225 psi, ASTM D 3786.
 - 4. Puncture: 65 lbs., ASTM D 4833.

5. Trapezoidal Tear: 45 lbs., ASTM D 4533.
6. U.V. Resistance (Strength Retained): 70%, ASTM D 4355.
7. Equivalent Opening Size: 70 min. U.S. Sieve Number, ASTM D 4751.
8. Permittivity: 2.5 sec.⁻¹, ASTM D 4491.
9. Flow Rate: 175 gal/min/ft², ASTM D 4491.

- B. Soil Reinforcement/Erosion Control Matting: Shall be a three dimensional geomatrix of heavy nylon monofilaments fused at their intersections, with 95% of the geomatrix being open space, meeting the following properties unless otherwise indicated.

<u>Property</u>	<u>Value</u>
Carbon Black content by weight	2%
Nominal Weight (02/yd ²)	12.0
Minimum Weight (02/yd ²)	11.1
Thickness (inches)	0.75
Minimum Filament Diameter (inches)	0.016
Tensile Strength (lbs/ft length)	250
Tensile Strength (lbs/ft length)	120
Tensile Elongation - Length (%)	75
Tensile Elongation - Width (%)	75

- C. Pavement Fabric for walks, track events and artificial turf field: As indicated on plans.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.
- C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, as ordered by Landscape Architect/ Engineer as required and/or as required by the Landscape Architect/ Engineer during all phases of construction.

3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project Site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
 1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required. Damage to existing and/or new components of the site due to excess water shall be repaired at no cost to the Owner and to the satisfaction of the Landscape Architect/Engineer.

3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.

3.4 EXCAVATION, GENERAL

- A. Classified Excavation: Excavation to subgrade elevations classified as earth and rock. Rock excavation will be paid for by adjusting the Contract Sum according to unit prices included in the Contract Documents.

1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; together with soil, boulders, and other materials not classified as rock or unauthorized excavation.
2. Rock excavation includes removal and disposal of rock.
 - a. Do not excavate rock until it has been classified and cross-sectioned by Landscape Architect/ Engineer.

3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete form work, for installing services and other construction, and for inspections.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS (where applicable)

- A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades. Refer to Section 312213 for subgrade tolerances.

3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
 1. Beyond building perimeter, excavate trenches to allow installation of pipe to the depths required by the Contract Documents. Refer to Section 312316.
- B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
 1. Clearance: 12 inches on each side of pipe or conduit, unless otherwise indicated.
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove

projecting stones and sharp objects along trench subgrade. Refer to Section 31 23 16: Trenching, Backfilling and Compaction, and Contract details.

3.8 APPROVAL OF SUBGRADE

- A. Notify Landscape Architect/ Engineer and Construction Manager when excavations have reached required subgrade.
- B. If the Landscape Architect/ Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
 - 1. Additional excavation and replacement material will be paid for under time and material as approved by the Landscape Architect/ Engineer.
- C. Proof roll subgrade with a 10-ton vibratory roller to identify soft pockets and areas of excess yielding. Soft pockets should be excavated and backfilled with Controlled Fill material. Do not proof roll wet or saturated subgrades. Proof roll to be witnessed by the Landscape Architect/ Engineer.
- D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as required by the Landscape Architect/ Engineer at no cost to the Owner.
- E. Subgrade compaction shall be as stated in Section 31 22 13: Rough Grading. Methods are the responsibility of the contractor.
- F. The Site Contractor is completely responsible for establishing the grades indicated within the tolerance indicated for the establishment of the subgrade. The subgrade shall be sloped mirroring the final grades of the turf field at those respective elevations allowing for the proper construction of the subbase system. The Site Contractor shall provide an as-built survey once the subgrade has been established to ensure it meets the required grades. The survey shall include spot grades at 20 feet on center in all directions. The Contractor shall make all necessary grade adjustments/corrections until such time that the subgrade has been approved.
- G. Subgrade shall be established using laser grades equipment only.

3.9 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavations under other construction or utility pipe as required by the Landscape Architect/ Engineer at no cost to the Owner.

3.10 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow materials and satisfactorily excavated soil materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of trees to remain.
 - 2. Stockpile at location approved by the Owner.

3.11 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:
 - 1. Construction below finish grade including, where applicable, damp roofing, waterproofing, and perimeter insulation.
 - 2. Surveying locations of underground utilities for record documents.
 - 3. Inspecting and testing underground utilities.
 - 4. Removing concrete formwork.
 - 5. Removing trash and debris.
 - 6. Removing temporary shoring and bracing, and sheeting.
 - 7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.12 UTILITY TRENCH BACKFILL

- A. Place and compact bedding course on trench bottoms and where required by the contract documents. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- B. Backfill trenches excavated under footings and within 18 inches of bottom of footings; fill with concrete to elevation of bottom of footings.
- C. Provide 4-inch-thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in minimum of 4 inches of concrete before backfilling or placing roadway subbase.
- D. Place and compact initial backfill of subbase material, free of particles larger than 1-inch, to a height of 12 inches over the utility pipe or conduit.
 - 1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides along the full length of utility piping or conduit to avoid damage or displacement of utility system.
- E. Coordinate backfilling with utilities testing.
- F. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.
- G. Place and compact final backfill of satisfactory soil materials to final subgrade.
- H. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.13 FILL

- A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.
- B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- C. Place and compact fill material in layers to required elevations as follows:

1. Under steps and ramps, use Structural Fill.
2. Adjacent to pavement areas: Structural Fill.
3. Under Asphaltic Pavement and Portland Cement Pavement: As indicated on Plans

3.14 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
 1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
 2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.15 COMPACTION OF BACKFILLS AND FILLS

- A. Place backfill and fill materials in layers not more than 12 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D-1557.
 1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill material at 95 percent.
 2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 95 percent.
 3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at a minimum of 85% and maximum of 90%.

3.16 GRADING

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
 1. Provide a smooth transition between adjacent existing grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

3.17 SUBSURFACE DRAINAGE (where applicable)

- A. Drainage Piping: As indicated on Plans.
- B. Subsurface Drain: Place a layer of drainage fabric around perimeter of drainage trench as indicated. Place a 6-inch course of filter material on drainage fabric to support

drainage pipe. Encase drainage pipe in a minimum of 12 inches of filter material and wrap in drainage fabric, overlapping sides and ends at least 6 inches. (Perimeter drain shall be as indicated on Plans.)

1. Compact each course of filter material to 95 percent of maximum dry unit weight according to ASTM D 698.
- C. Drainage Backfill: Place and compact filter material over subsurface drain, to width indicated, to within 12 inches of final subgrade. Overlay drainage backfill with one layer of drainage fabric, overlapping sides and ends at least 6 inches.
1. Compact each course of filter material to 95 percent of maximum dry density according to ASTM 698.
 2. Place and compact impervious fill material over drainage backfill to final subgrade.

3.18 DRAINAGE COURSE

- A. Under slabs-on-grade, place drainage course on prepared subgrade and as follows:
1. Compact drainage course to required cross sections and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D-1557.
 2. When compacted thickness of drainage course is 6 inches or less, place materials in a single layer.
 3. When compacted thickness of drainage course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.19 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.
- C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verifications and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by the Landscape Architect/ Engineer.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at locations and frequencies indicated in Specification Section 313200 - Soil Testing Services.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil depth required; recompact and retest until specified compaction is obtained.

3.20 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and re-establish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
 - 1. Scarify or remove and replace soil material to depth as required by the Landscape Architect Engineer; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

3.22 SPECIAL SITE CONDITIONS

- A. Contractor shall fully familiarize himself with the Geotechnical Report that describes the conditions at this site. Contractor shall follow site development guidelines identified in Geotechnical Report.

END OF SECTION 312300

SECTION 312316

TRENCHING, BACKFILLING AND COMPACTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Unclassified earth excavation for construction of pipe, conduit, manholes, catch basins, appurtenances, and structures outside of building lines.
- B. Disposal of excavated materials, salvage of material for backfill, and removal of excess or material not suitable for re-use.
- C. Maintenance of excavations including sheeting, dewatering, bridging and fencing outside of building lines.
- D. Construction of bedding, pipe zone and trench backfill, outside of building lines.
- E. Protection of utilities, outside of building lines.
- F. Protection of trenches and open excavations, outside of building lines.
- G. All work shall be in strict compliance with the Geotechnical Report.

1.3 RELATED SECTIONS

Section 02 30 00: Soil Testing Services.

Section 31 22 13: Rough Grading.

Section 31 23 00: Earthwork.

Section 33 11 16: Water System.

Section 33 40 00: Storm Sewer Systems.

1.4 QUALITY ASSURANCE

- A. Requirements of Regulatory Agencies:
 - 1. Comply with New York State Department of Labor Board of Standards and Appeals Part 23 of Title 12.
 - 2. Comply with Subpart P, "Excavations, Trenching and Shoring" of United States Department of Labor OSHA Regulations for Construction.
 - 3. Comply with rules, regulations, and laws concerning construction activity in roads of the applicable jurisdiction.
 - 4. Comply with all other applicable regulations.
- B. Testing Laboratory: As specified in Section 023000 Soil Testing Services.

C. Reference Standards: NYSDOT Specifications.

D. Allowable Tolerances:

1. Alignment of Excavation: To permit construction of pipe, structures, and appurtenances to the tolerances specified under pertinent drawings and specifications.
 - a. Trench bottom vertical alignment: Excavate to the required elevations below proposed pipes and other structures for proper vertical alignment. Do not over excavate below dimensions indicated for the proposed utilities.
 - b. Trench sides horizontal alignment: Do not excavate less than dimension shown on Contract Drawings. Note and comply with any limit of payment dimensions shown on plans or as specified.
2. Bedding: Construct bedding with specified material as indicated.

1.5 SUBMITTALS

- A. Reports: Before using material for special trench backfill, pipe zone backfill, or bedding, submit samples from each typical source to an approved soils testing laboratory and submit reports for approval as follows:
1. Submit six copies of the gradation analysis of gravel from each source used for trench backfill, bedding, or subbase.
 2. Submit six copies of the gradation analysis of crushed stone from each source.
 3. Submit six copies of the gradation analysis and compaction requirements for each typical class of select backfill used for trench backfill as shown on the plans:
 - a. Report from soils testing laboratory should state any special manipulation or compaction requirements required to achieve specified density or supportive value for each class of type of select backfill.
 - b. Re-testing of backfill compacted in place may be required at any time or place as required by the Landscape Architect/ Engineer.
- B. Shop Drawings: Prior to start of work, submit shop drawings and details, for all materials to be incorporated into the work.
- C. Samples: Prior to the start of backfill grading, submit the number and size of samples requested by the Owner and Landscape Architect/ Engineer for acceptance.
- D. Product Data: Submit products data for all materials, including but not limited to:
1. Plastic Warning Tape (each type).
 2. Geotextiles.
 3. Controlled low-strength material, including design mixture.
 4. Geofoam.
- E. All submittals must receive approval prior to being incorporated into work. Failure to do so shall be at the Contractor's risk and expense.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Store and stockpile material suitable for backfilling away from interference with traffic, and nearby residents. Use all stockpiled material as soon as practical. Do not allow material to become contaminated. Do not allow material to erode or wash into trench, onto road or adjacent property.
- B. Load and haul away excavated material not suitable for other uses at the site. Use haul routes approved by the municipality having jurisdiction.

1.7 PROJECT CONDITIONS:

- A. Notify: Dig Safely, 1-800-962-7962, not less than 72 hours prior to starting excavation for location of gas, telephone and electric lines.
- B. Notify other private and public utilities in the work area.
- B. Notify Owner and Landscape Architect/ Engineer at least 24 hours prior to commencing trenching and backfilling.

1.8 PROTECTION OF PERSONS AND PROPERTY

- A. It shall be noted and stressed that this contractor's installations will be made during a period when the existing building(s) are in use. Contractor shall schedule and conduct their operations so as to cause the least amount of inconvenience to the Owner. Contractor shall provide all possible safe-guards to protect students and others at the site.
- B. Barricade open excavations occurring as part of this work. Furnish night lighting as required.
- C. Contractor shall furnish, erect and maintain barriers where feasible or directed to separate construction activities from other operations on site. Gates may be provided where required. Contractor shall limit operations and activities to fenced areas where applicable.
- D. Protect structures, utilities, pavements and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards caused by earthwork operations.
- E. Perform any shoring and bracing required to safely do the work required. Maintain sides and slopes of elevations in a safe manner. Provide necessary sheet piling and/or shoring needed for protection of workman, materials, buildings, other properties, and the public.
- F. Locate excavations support and protection systems clear of permanent construction so that forming and finishing of concrete surfaces is not impeded.
- G. Monitor excavations support and protection systems daily during excavation progress and for as long as excavation remains open. Promptly correct bulges, breakage, or other evidence of movement to ensure that excavation support and protection systems remain stable.

- H. Promptly repair damages to adjacent facilities caused by installing excavation support and protection systems.
- I. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and bear soil and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.
- J. Contractor is responsible for all sheet piling and shoring required, any sheet piling provided is to be installed under supervision and approval of a Registered Professional Engineer in the State of New York.

1.9 EXISTING UTILITIES

- A. Locate existing underground utilities in areas of work. If utilities are to remain in place, provide adequate means of support and protection during earthwork operations.
- B. Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Landscape Architect, and then only after arranging to provide temporary utility services according to requirements indicated.
 - 1. Notify Landscape Architect not less than (2) days in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without Landscape Architect's written permission.
 - 3. Contact utility-locator service for area where Project is located before excavating.
- C. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner and Landscape Architect immediately for directions. Cooperate with Owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to the satisfaction of the utility owner.

1.10 WATER CONTROL

- A. Contractor shall furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control ground-water flow into excavations if required and permit construction to proceed on dry, stable subgrades.
 - 1. Maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, that excavation does not flood, and that damage to subgrades and permanent structures is prevented.
 - 2. Prevent surface water from entering excavations by grading, dikes, or other means.
 - 3. Accomplish dewatering without damaging existing buildings adjacent to excavation.
 - 4. Remove dewatering system if no longer needed.
- B. It is the responsibility of the Contractor to examine all available information prior to bidding to determine existing water table elevation. Dewatering must be covered in Base Bid, no extra compensation for dewatering will be allowed.
- C. Comply with water disposal requirements of authorities having jurisdiction.

- D. Installation: Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
- E. Before excavating below ground-water level, place system into operation to lower water below excavation depth. Operate system continuously until construction is complete and fill materials have been placed, or until dewatering is no longer required.
- F. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
- G. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed.

1.11 PIPING TRENCH EXCAVATION

- A. Excavation shall allow for direct buried anchors. The trench bottom must give uniform support along the entire length of any pipelines. Where several pipelines are located in a common trench, the trench must be wide enough to maintain the specified distances between adjacent lines. The excavation should be in a straight line except where fittings are located.
- B. The width of the trench at the top of the pipe should be held to the minimum required for efficient and proper installation but in accordance with current OSHA Standards.
- C. Where suitable soil exists, pipe shall be installed to comply with ANSI/ AWWA C151/ A21.51 Laying Condition Type 2. This shall consist of a flat bottom trench with undisturbed earth backfilled and lightly consolidated to centerline of pipe. Where drainage pipe is installed, bottom of trench shall be uniformly sloped. In all cases, pipe bells shall be excavated to provide uniform support.
- D. Where unsuitable material exists, pipe shall be installed to comply with ANSI/ AWWA C151/ A21.51 Laying Condition Type 4. This shall consist of a pipe bedded in sand, gravel or crushed stone ASTM D2940; except 100% passing a 1" (25mm) sieve and not more than 8% passing a No. 200 (.075mm) sieve; to depth of 1/8 pipe diameter, 4" minimum. Backfill compacted to top of pipe 80% Standard proctor factor AHSHTO T-99.
- E. If necessary to remove unsuitable material to a depth greater than specified, refill excavations carried below the depth indicated or directed with specified bedding material in 6-inch lifts compacted to 95% of maximum density in accordance with ASTM D1557, Method D. Excavate and replace soil disturbed and weakened by the Contractor's operations or soils permitted to soften from exposure to weather, with bedded material and compact with a plate-type vibratory compactor to the specified density.

1.12 REMOVALS

- A. Perform the work of demolition at the existing sites as indicated on the drawings and/or as required by the new construction. All materials removed shall be examined by the Owner. Those materials designated by the Owner as "scrap" shall become the property of the Contractor and removed from the site; Materials to be retained by the Owner shall be delivered to the Owner at location as directed.

- B. All excess soil removed from excavations, existing concrete sidewalks, etc. not to be reused as backfill, shall be trucked from the site and disposed of by the Contractor.

1.13 MAINTENANCE & REPAIR OF EXISTING FACILITIES

- A. Before work is started, the contractor shall inspect the existing work which will be affected by his operations. For the contractor this will include, but is not limited to, driveway, roads, lawn area, walks, shrubbery, etc.
- B. Contractor shall report in writing any observed defects to the Owner in order to avoid his being held responsible for damage which may not be his fault.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Imported Pipe Bedding:
 - 1. Crushed stone meeting New York State Department of Transportation (NYSDOT) Designation 703-4, Type 1A stone.
- B. Sand: An imported or native natural run-of-bank sand graded from fine to coarse particles, free of lumps and frozen material. It shall not contain slag, cinders, ashes, rubbish, vegetation, or other foreign material (shall not contain any stones larger than 1/2" diameter). (Native material must be approved by Landscape Architect/ Engineer).
- C. General Fill: Native onsite soils capable of meeting compaction requirements, and in accordance with the Geotechnical Report. (Material shall be approved by Landscape Architect/ Engineer).
- D. Processed Gravel: Gravel meeting NYSDOT 304-2.02 Type 4.
- E. Temporary Fencing (where required by site conditions):
 - 1. Materials may be new or used.
 - 2. Wire Fabric: 0.083 inch diameter (No. 14 B.W.D.) with maximum size openings of 2 inches wide, 4 inches high.
 - 3. Minimum height: Five feet.
 - 4. Posts: Metal. T or U Type, minimum length eight feet, driven into ground at least two feet.
 - 5. Signs: Size 16 inches by 24 inches with 5 inch black letters on orange background, message:

"DANGER-KEEP OUT".

2.2 SUITABLE BACKFILL MATERIAL

- A. Excavated or borrow material shall be predominantly granular, non-expansive and free from roots, rocks or lumps over 3" and deleterious matter.
 - 1. Gravel: Run of bank gravel, reasonable free of loam, silt and clay.
 - 2. Stone: Select, graded crushed stone, free from organic, frozen or deleterious

matter.

2.3 GRASS RESTORATION

- A. Grass Seed: Provide fresh, clean, new-crop seed complying with tolerance for purity and germination established by Official Seed Analysts of North America.
- B. Refer to Specifications 32 92 00 Lawns for more information.

2.4 PAVEMENT RESTORATION

- A. Provide Asphalt concrete base course per N.Y.S.D.O.T Section 401-2 Type 1 as noted below:
 - 1. Heavy Duty – 8" (in 2" lifts)
 - 2. Medium Duty – 3"
 - 3. Light Duty – 0"
- B. Provide Concrete 8" concrete base per N.Y.S.D.O.T Section 503 concrete class C or F.
- C. Provide 2" asphalt concrete binder course per N.Y.S.D.O.T. Section 401-2 Type 3.
- D. Provide 1-1/2" asphalt concrete top coat per N.Y.S.D.O.T. Section 401-2 Type 7F.
- E. Cap seams with bituminous asphalt filler per N.Y.S.D.O.T material designation 702-05 or 702-3401.

2.5 SOIL MATERIALS

- A. Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Sand: ASTM C 33; fine aggregate, natural, or manufactures sand.

2.6 GEOTEXTILES

- A. Refer to Section 33 46 26: Geotextiles Fabrics.

2.7 ACCESSORIES

- A. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils. thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
 - 1. Red: Electric.
 - 2. Yellow: Gas, Oil, Steam, and Dangerous Materials.
 - 3. Orange: Telephone and other Communications.
 - 4. Blue: Water Systems.
 - 5. Green: Sewer Systems.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Prior to all work, carefully inspect the site and verify that construction may properly commence.
 - 1. Before excavation, verify:
 - a. Work layout, horizontal and vertical, and conformance of layout with Contract Drawings.
 - b. Limits of construction.
 - c. Utility locations including, but not limited to: aerial, pole lines, buried, underground, transmission, local service, and individual connections.
 - 2. After excavation, verify that pipe, structures and appurtenances to be placed in trenches may be installed in accordance with pertinent drawings and specifications.
 - 3. Before backfilling, notify the Owner and Engineer at least 24 hours in advance and verify:
 - a. Pipe, structures and appurtenances have been installed in accordance with pertinent drawings and specifications, and joints are secure.
 - b. Utilities are adequately continued, supported and maintained without damage.
- B. In the event of discrepancy or unsatisfactory condition, immediately notify the Owner and Landscape Architect/ Engineer.

3.2 PREPARATION

- A. Utility Protection and Changes: Where public and/or private utilities are encountered:
 - 1. Maintain, support, and save from damage all public utilities.
 - 2. Allow reasonable time and space for owner of private utilities to cooperate in maintaining their facilities.

3.3 PERFORMANCE

- A. Excavation: Perform all trenching for construction of pipe, appurtenances, structures, bedding, and backfill. Remove surface materials and drainage facilities:
 - 1. Disposal of excavated material:
 - a. Store material suitable for backfill. Protect from contamination.
 - b. All surplus earth, rock and other unsuitable or unsatisfactory material shall be disposed of off project site by Contractor.
 - 2. Perform excavation in such manner and to such widths as will give ample room for installing the pipe, appurtenances and structures, and for sheeting, bracing, pumping and draining. Dewater the excavation and maintain the dewatered

condition as required to perform the construction and install compacted backfill.

3. Do not disturb bottom of excavation at structures requiring a cast-in-place concrete base. In case material is disturbed or saturated, carefully excavate to undisturbed level and fill with concrete at no additional cost to Owner.
 4. Unauthorized Excavation: Unauthorized excavations carried outside lines and grades shown on Contract Drawings shall be filled by Contractor at no additional cost to Owner as follows:
 - a. Below concrete cradle, concrete encasement or concrete foundation, fill unauthorized excavations with 3000 psi concrete.
 - b. Below specified bedding, fill unauthorized excavations with compacted bedding material.
 5. Maintenance of Trench:
 - a. Keep sides of excavation from slides, cave-ins. Use any method including but not limited to: temporary sheeting, shoring, bracing, and cribbing.
 - b. Keep excavations free from water. Use any method including but not limited to gravity flow, pumping, sumps. Maintain excavation in a dry condition until backfill has been placed and compacted a minimum of 18 inches above top of pipe. In all cases, maintain dry trench at backfill level.
 6. Schedule:
 - a. Advance excavation operations ahead of pipe laying to allow for field conditions.
 - b. Limit excavations ahead of pipe laying a maximum of 200 feet, unless more is approved by the Engineer in writing.
- B. Bedding and Pipe Zone Backfill: The trenches for pipelines shall have bottoms as shown on the Contract Drawings conforming to the required grades. All excavations for pipe lines shall be made to the depths shown for pipe bedding.
1. If the bottom of trench becomes unsuitable for pipe laying due to Contractor's operations, he shall provide extra excavation and backfill suitable to the conditions at the area and bedding specified, at no additional cost to Owner.
 2. If the undisturbed bottom of the trench is soft and, in the opinion of the Engineer, cannot support the pipe or structure, additional trench depth shall be excavated as ordered by the Engineer and refilled with specified bedding material.
 3. Bedding and Pipe Zone Placement:
 - a. Place and compact bedding material in trench bottom.
 - b. Install pipe conforming to the required line and grade.
 - c. Place and compact pipe zone backfill material in six-inch-thick layers as shown on the Contract Drawings.
 4. Bedding and Pipe Zone Compaction:

- a. Below pipe and structures: Compact to not less than 95% of modified proctor maximum density, at or below optimum moisture content in conformance with ASTM D 1557.
 - b. Material shall be deposited evenly on both sides of the pipe in tamped layers not exceeding 6 inches in depth until at least three-fourths the depth of the pipe has been reached. For wide trenches, tamping shall be done for a distance on each side of the pipe equal to at least the diameter of pipe. Any pipe that is damaged or moved out of alignment, regardless of cause, shall be replaced or realigned at the Contractor's expense.
- 5. Ditch Line Dikes: Construct an impervious earth dike at trench bottom, as required, and at property lines to keep free water from traveling downstream along solid pipes and eroding pipe bedding. Ditch line dikes are not to be installed in underdrain trenches.
 - a. Construct dike of clay or other impervious material.
 - b. Construct one foot thick and from bottom of trench to top of pipe and at every catch basin and manhole, at 100 foot intervals and at the inlet end of culverts.

C. Backfill - General:

- 1. Backfill excavations as shown on the Contract Drawings. Materials shall be placed and compacted from the top of the pipe zone backfill to the surface of the ground or the bottom of any special surface treatment, such as pavement subbase or topsoil.
 - a. Do not backfill against masonry walls or other structures until they have attained sufficient strength to safely resist the thrust of fill materials.
 - b. Do not backfill with frozen materials.
 - c. If settlement or washout occurs before Final Inspection, furnish, place and compact additional material to resurface the low places as required by the Owner.
 - d. Maintain dust control at all times.
- 2. Heavy equipment shall not be allowed to pass over the pipe until a fill of at least two (2) foot depth has been placed over the top of the pipe. In any case, movement of construction equipment and all other vehicles and loads over and adjacent to any pipe shall be done at the Contractor's risk. When determined by the Owner, any pipe that is damaged or disturbed through any cause, shall be replaced as required by the Owner, at the expense of the Contractor and at no cost to the Owner.
- 3. Methods of Compaction:
 - a. Hand Compaction: Tamping by hand with flat hand tampers.
 - b. Mechanical Compaction: Compaction by means of vibratory or other mechanical tampers.
- 4. Compact Backfill to 95% Modified Proctor Density Compaction:
 - a. Backfill material shall be placed in horizontal layers not exceeding six (6) inches thick and be thoroughly compacted by mechanical compaction.

D. Utility Protection:

1. Contractor shall hold the Owner harmless against:
 - a. Injury to electric, telephone lines, gas, water lines, and other underground and overhead utilities.

E. Temporary Wire Fence:

1. Where trenches and open excavation are left unattended during non-working hours or days, furnish and maintain temporary fences.
2. A temporary wire fence will be required except where temporary sheeting is extended a minimum of three feet above ground surface, and no void exists between sheeting and side of excavation.
3. Provisions for this fencing are in addition to provisions the Contractor would normally make to safeguard his work operations and in no way diminish his obligations in this respect.
4. Construction Details:
 - a. Construct temporary fence to completely surround all excavations.
 - b. Mount "DANGER-KEEP OUT" signs at intervals not exceeding 50 feet along fence line.
 - c. Provide posts or adequate supports for fencing at intervals not in excess of 10 feet. Stretch and fasten wire fabric at top, middle and bottom of each support.

3.4 FIELD QUALITY CONTROL

- A. Quality Control Testing During Construction: Testing laboratory must inspect and approve subgrades and fill layers before further construction work is performed thereon. Refer to Section 313200.
- B. If testing laboratory subgrade and/or fill reports are below specified density, provide additional compaction at no expense to Owner.

3.5 PAVMENT PATCHING

- A. Existing pavement shall be saw cut to obtain a straight and neat edge for paving. Saw cut shall be made prior to paving after backfill of trench to bottom of new pavement.
- B. All seams between existing and new asphalt surfaces shall be sealed with an asphalt filler corresponding to the material requirements of N.Y.S.D.O.T. Material designation 702-05 or 702-3401.
- C. Concrete for new base shall correspond to requirements of N.Y.S.D.O.T. section 503. Concrete class C or F.

- D. Top of new concrete base shall be even with or lower than top of existing concrete base to provide full thickness of asphalt top and binder and minimum 8" of concrete base.
- E. No asphalt shall be placed on concrete until the concrete develops a minimum strength of 2000 P.S.I. The minimum duration between placement of concrete and asphalt shall be 48 hours. Tack coat surface of the concrete prior to receiving asphalt. Tack coat shall correspond to the material requirement of N.Y.S.D.O.T. material designation 702-30.
- F. If an asphalt base course is present, the bottom of new asphalt base course shall match the bottom of or be set below bottom of existing asphalt pavement. Minimum thickness shall be:
 - 1. Heavy Duty Pavement – 8" (placed in 2-4" lifts)
 - 2. Medium Duty Pavement – 3"
 - 3. Light Duty Pavement – 0"
- G. Top of conduit shall be a minimum of 7'-0" below the surface of State highways and 30" below other paved roadways.

3.6 GRADING

- A. Uniformly grade areas within limits of this work, including adjacent transition areas. Compact with uniform levels or slopes between finished elevations and adjacent existing grades.
- B. Grade areas to achieve drainage away from structures and to prevent ponding.
- C. Soft spots are to be re-excavated and backfilled with suitable material.

3.7 MAINTENANCE

- A. Protect newly graded areas from traffic and erosion and keep free of trash and debris.
- B. Where compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape and re-compact to required density.

3.8 DISPOSAL OF EXCESS AND WASTE MATERIALS

- A. If specifically directed by Owners Representative, transport acceptable excess excavated material to designated soil storage areas on the Owner's Property.

END OF SECTION 312316

SECTION 312500

SEDIMENT AND EROSION CONTROL

PART 1 – GENERAL

1.1 SUMMARY

- A. Applicable provisions of the Contract Documents govern work under this section.

1.2 SUBMITTALS

- A. In accordance with Shop Drawings, Product Data, and Samples Specification Section, designate erosion control and maintenance activities on submitted Project Schedule.
- B. Submit pre-construction photographs and short narrative of erosion control implementation plan as specified herein.
- C. Project Schedule: Contractor shall provide construction schedule indicating schedule of work with key milestones for each phase of construction.
- D. Complete required forms and documentation as indicated in the project Stormwater Pollution and Prevention Plan (SWPPP).
- E. Qualified Inspector Certifications: Contractor shall provide Certifications of all Qualified Inspectors performing monitoring of Erosion & Sediment Control measures.

1.3 RELATED SECTIONS

Section 31 11 00: Clearing and Grubbing.
Section 31 23 00: Earthwork.
Section 31 23 16: Trenching, Backfilling and Compaction.
Section 32 12 16: Asphaltic Concrete Paving, Surfacing, and Striping.
Section 32 92 00: Lawns.

1.4 WORK INCLUDED

- A. Provide all labor, equipment and materials necessary to install and maintain erosion control blankets, silt fence, hay bale dikes, sediment traps, inlet protection, and to implement erosion control measures as shown on the plans, as specified, as required by regulatory permits, as required by the Landscape Architect/ Engineer if measures are not indicated on the plans, and as job conditions dictate.

1.5 QUALITY ASSURANCE

- A. All Erosion/Sediment Control activities and water quality objectives performed by the contractor shall be in compliance with the following standards of practice:
 - 1. NYSDEC's SPDES General Permit for Stormwater Discharges for Construction Activity Permit No. GP-0-15-002.
 - 2. NYSDEC's "New York Standards and Specifications for Erosion and Sediment Control" published by the Empire State Chapter of the Soil and Water Conservation

3. Society, latest edition.
 4. NYSDEC's "New York State Stormwater Management Design manuals" prepared by Center for Watershed Protection, latest edition.
 5. USDA Soil Conservation Service "Guidelines for Urban Erosion and Sediment Control, latest revision.
 6. NYSDEC Erosion and Sediment Control Guideline for New Development T.O.G.S. 5.1.10.
 7. Geotechnical Report for this project (See Appendix).
- B. Local Guidelines for Erosion and Sediment Control.
1. NYSDEC "Reducing the Impacts of Stormwater Runoff for New Developments", latest revision.
 2. NYSDOT Specifications.
- C. Contractor is responsible for all monitoring, reporting, and repair of erosion control measures as required by the SWPPP specific permit requirements throughout the duration of construction. Contractor shall provide a qualified inspector performing all Erosion & Sediment Control inspections.
- D. Directives of Owner, Owner's Representative, and/or regulatory personnel of authority having jurisdiction requiring further control measures as warranted.

PART 2 - PRODUCTS

2.1 MULCHES

- A. Mulches shall be suitable material acceptable to the Landscape Architect/ Engineer and reasonably clean and free of noxious weeds and deleterious materials. The following materials are acceptable:

Application Rates				
<u>Mulch Material</u>	<u>Quality Standards</u>	<u>Per 1000 SF</u>	<u>Per Acre</u>	<u>Depth</u>
Wood Chips or Shavings	Green or air-dried. Free of objectionable coarse material	500-900 lbs.	10-20 tons	2 - 7"
Straw	Air-dried; free of undesirable seeds & surface coarse materials	90-100 lbs. 2-3 bales	2 tons cover 100-120 bales	about 90%
Excelsior Wood Fiber Mats	Interlocking web of excelsior fibers with Photodegradable plastic netting	48" x 100" 2 sided plastic, 48"x 180"1 sided plastic	-----	-----

2.2 GRASS

- A. Grass shall be quick growing species suitable to the area and as a temporary cover which will not compete with the grasses sown later for permanent cover.

B. Seed Mixtures

1. Temporary Seeding

<u>Type</u>	<u>Lbs./Acre</u>	<u>Lbs./1000 SF</u>
Ryegrass (Annual or Perennial)	80	1.9
Certified "Aroostook" Winter Rye	100	2.5

Use winter rye if seeding in October/November.

2.3 SOIL AMENDMENTS

- A. Fertilizer and soil conditioners shall be a standard commercial grade acceptable to the Landscape Architect/ Engineer.
1. Lime: pH of 6.
 2. Fertilizer: Meeting New York State Department of Transportation Specification 713-03 type 1 or as approved. 1-2-1 N.P.P. ratio.

2.4 JUTE MESH

- A. Jute mesh and appurtenances shall comply with NYSDOT Specification Section 612, latest revision.

2.5 SILT FENCE

A. Field Assembled Units

1. Fabric shall meet the following minimum criteria:

<u>Property</u>	<u>Minimum Acceptable Value</u>	<u>Test Method</u>
Grab Tensile Strength (lbs.)	90	ASTM D1682
Elongation at Failure (%)	50	ASTM D1682
Mullen Burst Strength (psi)	190	ASTM D3786
Puncture Strength (lbs.)	40	ASTM D751 (Modified)
Slurry Flow Rate (gal/min/sf)	0.3	
Equivalent Opening Size	40-80	US Std Sieve CW-02215
Ultra-Violet Radiation Stability (%)	90	ASTM G-26

2. Posts

- a. Wood: Oak or similar quality hardwood, 3.0 square inches cross-sectional area

- minimum.
 - b. Steel: Standard T or U section weighing 1.00 pound per linear feet minimum.
 - 3. Mesh
 - a. 14-1/2 gauge minimum with 6 inch maximum mesh opening, plastic safety fence, orange or black, or as approved.
 - B. Prefabricated Units
 - 1. Pre-assembled units meeting the material requirements of 2.5 A may be used in lieu of field assembled units.
- 2.6 CHEMICAL BINDER
- A. Non-toxic conforming to Item 713-12 of NYSDOT Specifications.
- 2.7 RIP-RAP
- A. Per NYSDOT Specifications.
- 2.8 FILTER STONE
- A. Sound durable stone per NYSDOT Specification Section 703, size(s) per plans.
- 2.9 TURF REINFORCEMENT MATTING
- A. VMAX Model SC250 UV-stable polypropylene permanent matting as manufactured by RollMax Rolled Erosion Control or approved equivalent.
 - 1. 70% Straw Fiber / 30% Coconut Fiber.
 - 2. Thread: Polypropylene UV Stable.
 - 3. Thickness: 0.62 in.
 - 4. Resiliency: 95.2%.
 - 5. Density: 0.891 g/cm³.
 - 6. UV Stability: 100%.
 - 7. Light Penetration: 4.1%.
 - 8. Porosity: 99%.
 - 9. Tensile Strength: 709 lbs/ft.
 - 10. Elongation: MD=23.9% / TD=36.9%.

PART 3 - EXECUTION

3.1 GENERAL

- A. **The contractor is responsible for completing all monitoring, and reporting as required throughout the duration of construction as required, and provide reports to the Owner's Representative, and Landscape Architect for acceptance.**
- B. Contractor shall implement erosion control measures as indicated in the SWPPP, shown

on the plans, as job conditions dictate, and to comply with the local municipality. Intent is to minimize erosion and pollutants at the source, capture sediment at regular intervals and prevent sediment intrusion into storm sewer pipes, structures, and waterways. Work includes, but is not limited to, hay bales, mulching, temporary silt fences, filter fabric, expeditious grading, stormwater diversion, prompt turf establishment, sediment dikes, and maintenance of same. **The contractor is responsible for controlling all runoff from the site during the period of construction.** If erosion control measures are not shown on the Plans, he will be instructed by the Landscape Architect/ Engineer on where to implement them at no cost to the Owner.

- C. The Contractor shall initiate stabilization measures as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, but in no case more than 14 days after the construction activity in that portion of the site has temporarily or permanently ceased. If disturbed soil surfaces are to be left exposed for a period of greater than 14 days, stabilize the soil with temporary seeding and/or mulch to limit erosion. Where the initiation of stabilization measures by the 14th day after construction activity temporarily or permanently ceased is precluded by snow cover or frozen ground conditions, stabilization measures shall be initiated as soon as practicable. The onset of seasonally adverse weather shall not be used as an excuse for not implementing the necessary erosion controls. The Contractor shall use foresight in his activities to only disturb areas that he can stabilize before adverse weather conditions prevail. The Contractor is encouraged to schedule his work such that final land surface restoration closely follows initial disturbance to the maximum extent possible in order to limit bare soil exposure and dependence on the temporary systems discussed above.
- D. Sediment shall be removed from sediment traps or sediment ponds whenever their capacity has been reduced by fifty (50) percent from the design capacity and/or as required to ensure intent. Prior to fine grading and restoration, the Contractor shall remove and dispose of accumulated sediments and silts as required.

3.2 AUTHORITY OF WORK

- A. The Landscape Architect/ Engineer has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, the surface area of erodible earth material exposed by excavation, borrow and fill operations and to require the Contractor to provide immediate permanent or temporary pollution control measures to prevent contamination of adjacent streams or other watercourses/ waterbodies.

3.3 POLLUTION CONTROL

- A. Provide methods, means and facilities required to prevent contamination of soil, water or atmosphere by the discharge of noxious substances from construction operations. Promptly repair equipment leaks. Provide equipment and personnel to perform emergency measures required to contain any spillages, and to remove contaminated soils or liquids.
- B. Notify Owner, Landscape Architect/ Engineer and regulatory authority having jurisdiction if contaminated soil, groundwater or other form of pollution is encountered. Excavate and dispose of any contaminated earth immediately in accordance with Federal, State and local regulations off-site, and replace with suitable compacted fill.

- C. Pollutants such as fuels, lubricants, bitumen's, raw sewage and other harmful materials shall not be discharged into or near rivers, streams, and impoundments or into natural or man-made channels leading thereto. Wash water or waste from concrete mixing operations or trucks shall not be allowed to enter live streams.

3.4 STREAM CROSSINGS

- A. Frequent forging of live streams will not be permitted; therefore, temporary bridges, or other structures, shall be used wherever an appreciable number of stream crossings are necessary. Unless otherwise approved in writing by the Landscape Architect/Engineer, mechanized equipment shall not be operated in a live stream.

3.5 DEWATERING AND WASHWATERS

- A. Water from aggregate washing, equipment washing, dewatering or other operations containing sediment, shall be treated by filtration, settling basin or other means sufficient to reduce the turbidity, so as not to cause a substantial visible contrast to natural conditions.

3.6 DIVERSION BERMS/SWALES

- A. Slopes of significantly barren slopes exceeding 15 percent require special treatment such as water diversion berms/swales, straw bale sediment barriers, sodding, approved mulch tacking agent over straw mulch applied over seeded areas, or a combination thereof.

3.7 SILT FENCE INSTALLATION

- A. A silt fence may be used subject to the following conditions:

1. Maximum allowable slope lengths contributing runoff to a silt fence are:

<u>Slope Steepness</u>	<u>Maximum Slope Length (Ft)</u>
2:1	50
3:1	75
4:1	100
5:1	150
Flatter than 5:1	150 or as shown on the plans

2. Maximum drainage area for overland flow to a silt fence shall not exceed ½ acre per 100 feet of fence.
3. Erosion would occur in the form of sheet erosion.
4. There is no concentration of water flowing to the barrier.

- B. Woven wire fence to be fastened securely to fence posts with wire ties or staples.
- C. Filter cloth to be fastened securely to woven wire fence with ties spaced every 24 inches at top and mid-section.
- D. Embed silt fence material a minimum of 6 inches below finished grade.

- E. When two sections of filter cloth adjoin each other, they shall be overlapped by six inches and folded.
- F. Maintenance shall be performed as needed and material removed when “bulges” develop in the silt fence, or when 6 inches of sediment has accumulated against it, whichever occurs first. All sediment barriers shall be repaired or replaced when they no longer function as a barrier.

3.8 CONSTRUCTION OPERATIONS

- A. When borrow material is obtained from other than commercially operated sources, erosion of the borrow site shall be so controlled, both during and after completion of the work so that erosion will be minimized and sediment will not enter streams or other bodies of water. Waste or disposal areas and construction roads shall be located and constructed in a manner that will minimize sediment-entering streams. Install sediment containment devices around stockpiles and waste areas. Stabilize the surface of temporary haul roads to minimize sediment creation.
- B. Install stabilized construction entrances at all ingress/ egress points to local and state roads as required and as detailed on the plans.

3.9 CONSTRUCTION PHOTOGRAPHS

- A. The Contractor shall take good quality photographs of streams, ditches, channels, ponds or other water bodies immediately adjacent to project work area that will receive runoff from construction activity. Document existing conditions such as existing sediment deposition, water turbidity, eroded streambed/ streambanks and condition of vegetation.

3.10 CONSTRUCTION SCHEDULE

- A. Prior to beginning construction, the Contractor shall submit a detailed project schedule which outlines his program for controlling erosion, limiting conveyance of silt and sediment, pollution prevention, maintenance of devices/ controls, and restoration of graded surfaces for the duration of the project and the one-year warranty period, for review and acceptance.
- B. The Landscape Architect/ Engineer may limit the area of clearing and grubbing, excavation, trenching and embankment operations in progress, commensurate with the Contractor’s capability, responsiveness, and progress in keeping the finish grading, mulching, seeding and other such permanent control measures current in accordance with the accepted schedule. Should season limitations make such coordination unrealistic, temporary erosion control measures shall be taken immediately to the extent feasible.

3.11 FINAL STABILIZATION

- A. Final stabilization is defined as all soil disturbing activities at the site have been completed, and that a uniform perennial vegetative cover with a density of at least 80% has been established or equivalent stabilization measures (such as the use of mulches or geotextiles) have been employed on all unpaved areas and areas not covered by permanent structures.

3.12 REMOVAL OF TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES

- A. Remove erosion control devices when final stabilization has occurred for the respective areas of the site and are no longer needed.

3.13 CONTRACTOR'S RESPONSIBILITY

- A. Contractors are responsible for the performance of their subcontractors and to ensure they properly comply with the Erosion Control Measures, where applicable.
- B. The actual scheduling and implementation of Erosion Control Measures and Maintenance of required water quality is the responsibility of the Contractor(s). The erosion and sediment control plan and devices shown are considered to comprise the majority of efforts needed, but not necessarily all that will be required. Weather, site and unforeseen conditions can dictate that greater efforts will be necessary.

END OF SECTION 312500

SECTION 321000

ROADWAY AND MISCELLANEOUS SUBBASE

PART 1 – GENERAL

- 1.1 **RELATED DOCUMENTS:** Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.

1.2 **WORK INCLUDED**

- A. Construction of roadway subbase and miscellaneous surface subbase (drives, parking, concrete walk), or as indicated on the Plans.

1.3 **RELATED SECTIONS**

Section 02 30 00: Soil Testing Services.

Section 31 22 13: Rough Grading.

Section 31 23 16: Trenching, Backfilling, and Compacting.

Section 32 12 16: Asphalt Concrete Paving, Surfacing and Striping.

Description of System: Roadway and miscellaneous surfaces subbase shall be constructed in all excavations within paved areas.

1.4 **QUALITY ASSURANCE**

- A. Requirements of Regulatory Agencies:

1. Comply with rules, regulations, laws concerning construction activity in roads of the applicable jurisdiction.
2. Comply with all other applicable regulations.

- B. Testing Laboratory: As specified.

- C. Reference Standards: NYSDOT Specs.

- D. Comply with Geotechnical Report.

1.5 **SUBMITTALS**

- A. Samples: Before using material for roadway or miscellaneous surface subbase, submit samples from each typical source to the testing laboratory and submit reports for approval as follows:

1. Submit six copies of the gradation analysis and compaction requirements for material used.
 - a. Report from soils testing laboratory should state any special manipulation or compaction requirements required to achieve specified density or supportive value for all material.
 - b. Retesting of material compacted in place may be required at any time or

place as required by the Engineer or Landscape Architect.

- B. Manufacturer's Data: Geotextile.

1.6 PROJECT CONDITIONS

- A. Notify Owner, Landscape Architect, and Construction Manager at least 24 hours in advance of commencing the Work of this Section.
- B. Existing Conditions: Subgrade should be dry and not spongy before commencing the Work of this Section.
- C. Environmental Conditions: Do not commence the Work of this Section if subgrade is wet, frozen or covered with snow, or if forecasts predict such conditions within 8 hours.

1.7 SEQUENCING AND SCHEDULING

- A. Schedule the Work of this Section to commence as soon as possible after:
 - 1. Underground systems have been installed.
 - 2. Subgrades have been established.
 - 3. Subgrades have been proof-rolled.
 - 4. Subgrades have been accepted.

PART 2 - PRODUCTS

- 2.1 All products shall be as shown on the Plans.

PART 3 - EXECUTION

- 3.1 Subgrades which are spongy or otherwise unacceptable during proof-rolling shall be dug out and filled with subbase material at no additional cost to the Owner. Failure to do so shall be at the Contractor's risk and cost.
- 3.2 Roadway and Miscellaneous Surface Subbase shall be spread in such depths that the maximum thickness of any layer, after compacting, shall be 6 inches. Water shall be added in such amounts in order to obtain satisfactory compaction.
- 3.3 Compaction shall be to 95% Modified Proctor density in accordance with ASTM D-1557 accomplished with either a smooth steel wheeled roller having a minimum weight of 10 tons, or a pneumatic tired roller having an operating weight of not less than 1000 pounds per tire.
- 3.4 Testing laboratory must inspect and approve subgrades and fill layers before further construction work is performed thereon. Refer to Section 02 30 00 – Soil Testing Services. If testing laboratory subgrade and/ or fill reports are below specified density, provide additional compaction at no expense to Owner.

END OF SECTION 321000

SECTION 32 12 16

ASPHALT CONCRETE PAVING, SURFACING, AND STRIPING

PART 1 – GENERAL

- 1.1 RELATED DOCUMENTS: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- 1.2 WORK INCLUDED: Construction of two course pavements, pavement markings and pavement overlays at the locations shown on the drawings and as specified, including the outdoor classroom.
- 1.3 RELATED SECTIONS
 - Section 31 11 00: Clearing and Grubbing.
 - Section 31 23 00: Earthwork.
 - Section 31 23 16: Trenching, Backfilling, and Compaction.
 - Section 32 10 00: Roadway and Miscellaneous Subbase.
- 1.4 SUBMITTALS
 - A. Product Data: For each type of product.
 - B. Material Certifications: Contractor shall provide material certifications for all products and certify that all material items comply with or exceed specified requirements.
 - C. Compaction Tests: Contractor shall provide compaction test results for all products and certify that all tests comply with or exceed specified requirements.

PART 2 - PRODUCTS

- 2.1 TRUING AND LEVELING (if required): These mixtures shall meet the requirements of New York State Department of Transportation (NYSDOT) Specification 401-2.02 Type 7 Top and Type 5 Shim, as thicknesses dictate.
- 2.2 TOP COURSE: This mixture shall meet the requirements of NYSDOT Specification 403.13 Type 6 Top. Asphalt content shall be between 6.0 and 8 percent. Thickness per plans.
- 2.3 BINDER COURSE: This mixture shall meet the requirements of the NYSDOT Specification 403.13 Type 3 Binder. Asphalt content shall be between 4.5 and 6.5 percent. Thickness per plans.
- 2.4 PAVEMENT MARKING PAINT: Chlorinated rubber-alkyd type, FS TT-P-115, Type III as follows:
 - A. White: DOT Specification Section 727-03. (1985)
 - B. Yellow: DOT Specification Section 727-04.
 - C. Blue: Franklin Paint Company, Hydrophast Waterborne Traffic Paint, or

approved equivalent.

- 2.5 TACK COAT: NYSDOT approved, asphalt emulsion, material designation 702-90.

PART 3 - EXECUTION

- 3.1 Prior to placing pavements, ensure area to be paved matches all dimensions as indicated on Contract Drawings, and verify that surfaces to be paved have been properly prepared.
- 3.2 INTERFACE: Edges of existing bituminous pavement to be restored or extended shall be saw-cut in straight lines. Apply tack coat on edges before paving against. Appropriate time for tack coat to set varies with temperature.
- 3.3 An asphalt concrete truing and leveling course shall be placed at locations where the existing pavements require filling to provide a uniform surface upon which pavement resurfacing can be installed.
- 3.4 COMPACTION: Immediately after the bituminous mixture has been spread, struck off and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. The surface shall be rolled when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking or shoving. All courses shall be initially rolled with the roller travelling parallel to the centerline of the pavement beginning at each edge and working toward the center. Banked curves shall be rolled starting at the low side edge and working toward the super-elevated edge. When the compaction procedure used by the Contractor fails to produce results acceptable to the Engineer, the procedure shall be adjusted to obtain the desired results. Rollers shall move at a slow and uniform speed. The roller drive roll or wheel shall be nearest the paver.

Any displacement occurring as a result of the reversing of the direction of a roller, or from other causes, shall be corrected at once by the use of rakes and addition of fresh mixture as required. Care shall be exercised in rolling not to displace the line and grade of the edges of the bituminous mixture. To prevent adhesion of the mixture to the rollers, the wheels shall be kept properly moistened with water or water mixed with small quantities of detergent or other approved material, but in no case shall a solvent having effect upon the bituminous pavement be used.

Along forms, curbs, headers, walls and other areas not accessible to the rollers, the mixture shall be thoroughly compacted with mechanical tampers as required to achieve compaction equivalent to compaction produced by the roller. On depressed areas, a trench roller or a small vibratory roller approved by Architect may be used. Cleated compression strips also may be used under the roller to transmit compression to the depressed area.

Suitable means shall be provided to keep pavers and other equipment and tools free from bituminous accumulations. The surface of the pavement shall be protected from drippings of oil, kerosene, or other materials used in paving and cleaning operations.

Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective, shall be removed and replaced with fresh hot mixture, which shall be compacted to conform to the surrounding area. Any area showing an excess or deficiency of bituminous material shall be corrected to the satisfaction of the Engineer.

All bituminous concrete courses shall be initially rolled with an approved steel-wheel

roller. The roller shall overlap the previous roller pass by one-half the width of the roller.

3.5 SURFACE TOLERANCE:

- A. Grade: The contractor shall perform grade conformance tests (witnessed by the Owner's Representative) on both the binder course and the top course. Both surfaces should have positive drainage.
- B. Planarity: After completion of the finish rolling operations on each course, the contractor shall test (witnessed by the Owner's Representative) the compacted surface with a 10-foot straightedge. Measurement shall be made perpendicular to and across all mats at a distance not to exceed 25 feet. The maximum allowable planarity deviation with a pass shall be 1/8 inch in 10 feet when measured in any direction. Variations exceeding the allowable tolerances shall be corrected at no additional cost to the satisfaction of the Engineer, including completely relaying the pavement if required. The general contractor shall be completely responsible for establishing this slope. Any areas not in compliance shall be corrected at the cost of the general contractor.

Material which is part of a truing or leveling course will not be considered in pavement thickness determinations.

- 3.6 TEMPERATURE: Bituminous concrete shall have a mixing and placing temperature range between 250°F and 325°F and shall be placed only when the roadway surface is 50°F or above and rising, or as required by Engineer.

- 3.7 Existing pavement shall be cleaned by the use of approved mechanical sweepers in a manner approved by the Engineer. Ruts and depressions below the general surface that are not adequately cleaned by the use of mechanical sweeper shall be cleaned by hand brooms to the Engineer's satisfaction. The pavement and shoulders, if applicable, shall be kept clean until the overlay operations are completed.

- 3.8 Potholes and areas that are determined by the Engineer to be in need of repair shall be cleaned of debris before the new pavement is placed, receive a tack coat, as specified and as required, and shall be filled with bituminous material, asphalt concrete Type 5.

- 3.9 TACK COAT EQUIPMENT: The Contractor shall provide a distributor for applying the tack coat. The distributor shall be designed, equipped, maintained and operated so that the tack coat can be heated and applied uniformly on variable widths of surface up to 15 feet at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard. Distributor equipment shall include a tachometer, accurate metering device or a calibrated tank, and a thermometer for measuring temperatures of tank contents. Distributors shall be equipped with a power unit for the pump, and full circulation spray bars adjustable laterally and vertically. Smaller power spray units of hand spray equipment will be permitted only in areas where the Engineer determines that the use of a distributor is impractical.

- 3.10 APPLICATION OF TACK COAT: The tack coat shall be uniformly applied by a pressure distributor to a prepared clean pavement immediately prior to the placing of the new overlay. Tack coat shall be applied as approved by the Engineer to offer the least inconvenience to traffic, to permit one-way traffic, where practical, to prevent pickup or tracking of the bituminous material. Tack coat shall not be applied on a wet pavement surface or when the surface

temperature is below 45 degrees Fahrenheit. The temperature and areas to be treated shall be approved by the Engineer prior to application. The application rate shall be 0.05 to 0.07 gallons per square yard as approved by the Engineer.

- 3.11 Prior to painting pavements, sweep clean all surfaces to remove loose material and dirt.
- 3.12 Apply paint with mechanical equipment to produce uniform straight edges without fogging. Apply two coats at manufacturer's printed recommended rates. Apply paint as specified in New York State Department of Transportation Specification Section 640.
- 3.13 Following painting, provide the necessary protective measures to properly cure the painted areas. Allow sufficient time for proper curing as per the paint manufacturer's printed recommendations.

END OF SECTION 321216

SECTION 321243

POROUS FLEXIBLE PAVING

PART 1 – GENERAL

- 1.1 RELATED DOCUMENTS: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.
- 1.2 WORK INCLUDED
- A. Construction of reinforced grass fire lane along asphalt emergency access route for vehicular and heavy load support (emergency vehicles and fire trucks).
- 1.3 RELATED SECTIONS
- Section 31 23 00: Earthwork
Section 32 10 00: Roadway & Miscellaneous Surface Subbase
Section 32 12 16: Asphalt Concrete Paving, Surfacing and Striping
Section 32 92 00: Lawns
- 1.4 REFERENCES
- A. ASTM D 638-10 Standard Test Method for Tensile Properties of Plastics
- B. ASTM C 33 Standard Specification for Concrete Aggregates
- C. AASHTO M6 Standard Specification for Fine Aggregate for Hydraulic Cement Concrete
- 1.5 SYSTEM DESCRIPTION
- A. The Porous Flexible Paving porous pavement system provides vehicular (fire truck) and pedestrian load support for grass areas, while protecting grass roots from harmful effects of traffic.
- B. Major Components of the Complete System
1. Porous Flexible Paving units, assembled in rolls.
 2. Engineered sand and gravel base course.
 3. Hydrogrow soil amendment and fertilizer, supplied with Porous Flexible Paving.
 4. Sand fill or USGA greens mix.
 5. Selected grass from seed, hydroseeding/hydro-mulching, or sod.
 6. Selected topsoil (only for seeded installation).
 7. Mulch (needed only for seeded or hydroseeded installations).
- C. The Porous Flexible Paving grass paving units, sand, and base course work together to support imposed loading.
- D. The Porous Flexible Paving grass paving units, Hydrogrow, and sand fill contribute to vegetation support.

1.5 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Shop Drawings: Submit design detail showing proper cross-section.
- C. Samples: Submit manufacturer's sample of Porous Flexible Paving 10" x 10" section of Porous Flexible Paving material.
- D. Installation Instructions: Manufacturer's printed installation instructions. Include methods for maintaining installed products.
- E. Certificates:
 - 1. Manufacturer signed certificate stating the product is made in the USA.
 - 2. Submit Material Certificates for base course and sand (or USGA mix) fill materials
 - 3. Product certificates signed by the manufacturer certifying material compliance of polyethylene used to make Porous Flexible Paving units.
 - 4. ISO Certificate certifying manufacturer's quality management system is currently registered to ISO 9001:2008 quality standards.
- F. Substitutions: No material will be considered as an equivalent to the Porous Flexible Paving unit specified herein unless it meets all areas of this specification and supports H-20 loading (80,000 lb. fire trucks).
- G. Manufacturer's Material Certification: Product manufacturers shall provide certification of compliance with all applicable testing procedures and related specifications upon written request. Request for certification shall be submitted by the purchasing agency no later than the date of order placement.
- H. Product manufacturers shall also have a minimum of 10 years' experience producing products for porous pavement systems.
- I. Manufacturer Quality Certification: ISO Certification certifying manufacturer's quality management system.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Protect Porous Flexible Paving units/rolls from damage during delivery and store rolls upright, under tarp, to protect from sunlight, when time for delivery to installation exceeds one week.
- C. Store Hydrogrow in a dark and dry location.
- E. Handling: Protect materials during handling and installation to prevent damage.

1.7 MAINTENANCE SERVICE

- A. Installer responsible for maintenance of grass plants – water/irrigation, fertilizing, mowing – until accepted by Engineer. DO NOT AERATE. See Porous Flexible Paving Maintenance Guide from manufacturer for suggested maintenance.

- B. System to be maintained by Contractor for a minimum of one growing season, until acceptance by Engineer / Architect.

1.8 PROJECT CONDITIONS

- A. Maintain environmental conditions within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Do not begin installation of porous pavements until all hard surface paving adjacent to porous pavement areas, including concrete walks and asphalt paving, is completed.
- C. Install turf when ambient air temperatures is at least 55 degrees F (13 degrees C).
- D. In cold weather, do not use frozen materials or materials mixed or coated with ice or frost, and do not build on frozen base or wet, saturated or muddy subgrade.
- E. Protect partially completed paving against damage from other construction traffic when work is in progress.
- F. Adequately water sod or grass seed to assure germination of seed and growth of root system.
- G. Grass coverage on the sand-filled Porous Flexible Paving rings must be completed within one week: See Part 3 Execution.
- H. DO NOT DRIVE, PARK ON, or use Porous Flexible Paving system for two or three mowing cycles until grass root system has matured (about 3 to 4 weeks for sod or 6 to 8 weeks for seeded areas). Any barricades constructed must still be accessible by emergency and fire equipment during and after installation.

1.9 LIMITED WARRANTY

- A. Invisible Structures, Inc. (ISI) warrants to its purchasers that all products furnished by ISI will be free from defects in material and/or workmanship.
- B. This warranty shall be extended for a period of five (5) years following the date of shipment by ISI.
- C. Providing a written claim is presented to ISI within the warranty period and after inspection by ISI showing the materials have failed under this warranty, all defective materials shall be refurbished under this warranty, at no charge, excluding re-installation costs. This in lieu of all other warranties expressed or implied and is the sole warranty extended by ISI.
- D. Our liability under this warranty is limited to the refurbishing of materials and does not include any responsibility for incidental, consequential, or other damages of any nature.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Invisible Structures, Inc., which is located at: 3510 Himalaya Rd. Suite 200; Aurora, CO 80011; Tel: 303-233-8383; Web: www.invisiblestructures.com, or approved equivalent.

B. Substitutions: Submit all documentation / testing / information for evaluation as an approved equivalent. Failure to provide adequate testing information will result in rejection of submittal.

2.2 POROUS FLEXIBLE PAVING PRODUCT

A. Composition:

1. Manufactured in the USA.
2. High density polyethylene (HDPE): 100 percent recycled materials.
3. Color: black
4. Color Uniformity: Uniform color throughout all units rolls.
5. Carbon Black for ultraviolet light stabilization.
6. Hydrogrow soil amendment and fertilizer, provided by manufacturer with Porous Flexible Paving.

B. Performance Properties:

1. Maximum Loading Capability: 15,940 psi (2.29 million psf, 109,906 kPa) when filled with sand.
2. Wheelchair Access testing for ADA Compliance: Passing ASTM F 1951-08.
3. Wheelchair Access testing for ADA Compliance: Passing Rotational Penetrometer testing.
4. Tensile strength, pull-apart testing: 458 lbf/in from ASTM D638 Modified.
5. System Permeability (Porous Flexible Paving, sand, base course): 2.63 to 38.55 inches of water per hour.
6. Effective Imperviousness (E.I.): 10%.

C. Dimensions (individual units are assembled and distributed into rolls):

1. Roll area: From 108 sq ft (10 sq m) to 538 sq ft (50 sq m), in 108 sq ft (10 sq m) increments
2. Roll Widths: From 3.3 ft (1 m) to 8.2 ft (2.5 m), in 1.6 ft (0.5 m) increments.
3. Roll Lengths: From 32.8 ft (10m) to 65.6 ft (20 m), in 3.3 ft (1 m) increments.
4. Roll Weights: From 41 lbs (19kg) to 205 lbs (93kg), in 41 lbs (19 kg) increments.
5. Unit Nominal Width by Length: 20 inches by 20 inches (0.5 m by 0.5 m) or 40 inches by 40 inches (1 m by 1 m).
6. Nominal Depth: 1 inch (2.5 cm) – for rolls and individual units.
7. Unit Weight: 18 oz (510 g) or 5 lbs. (2.27 kg).
8. Volume Solid: 8 percent.

2.3 SYSTEM MATERIALS

A. Base Course: Sandy gravel material from local sources commonly used for road base construction (recycled materials such as crushed concrete or crushed asphalt are NOT acceptable).

1. Conforming to the following sieve analysis and requirements:
 - a. 100 percent passing sieve size 1 inch (25 mm).
 - b. 80-100 percent passing sieve size 3/4 inch (19 mm).
 - c. 60-80 percent passing sieve size 3/8 inch (9 mm).
 - d. 40-60 percent passing sieve size #4.
 - e. 25-40 percent passing sieve size #10.
 - f. 5-25 percent passing sieve size #40.

- g. 0-5 percent passing sieve size #200.
 - 2. Provide a base course material nearly neutral in pH (range from 6.5 to 7.2) to provide adequate root zone development for turf.
 - 3. Material may be either "pit run" or "crusher run." Avoid using clay based crusher run/pit run. Crusher run material will generally require coarse, well-draining sand conforming to AASHTO M6 or ASTM C 33 to be added to mixture (20 to 30 percent by volume) to ensure long-term porosity.
 - 4. Alternative materials such as crushed shell, limerock, or crushed lava may be used for base course use, provided they are mixed with sharp sand (20 to 30 percent) to ensure long-term porosity, and are brought to proper compaction. Without added sand, crushed shell and limerock set up like concrete and become impervious.
 - 5. Alternative size and/or composition of base course materials should be submitted to Invisible Structures, Inc. (Manufacturer) for approval.
- B. Sand Fill for Rings and Spaces Between Rings: Clean sharp sand (washed concrete sand). Choose one of the following:
- 1. Coarse, well-draining sand, such as washed concrete sand conforming to AASHTO M6 or ASTM C-33.
 - 2. United States Golf Association (USGA) greens, section - sand mix "The Root Zone Mixture."
- C. Turf Conditioner:
- 1. Hydrogrow a proprietary soil amendment manufactured by Invisible Structures, Inc. and provided with Grasspave2.
- D. Grass – see lawns specification for seed mixture
- 1. Sod: Use 13 mm (0.5") thick (soil thickness) rolled sod from a reputable local grower. Species should be wear resistant, free from disease, and in excellent condition. Sod shall be grown in sand or sandy loam soils only. Sod grown in soils of clay, silt, or high organic materials such as peat, will not be accepted.
 - 2. Seed: Use seed materials, of the preferred species for local environmental and projected traffic conditions, from certified sources. Seed shall be provided in containers clearly labeled to show seed name, lot number, net weight, % weed seed content, and guaranteed % of purity and germination. Pure Live Seed types and amount shall be as shown in specifications.
 - a. Mulch – needed only for hydroseeding: Wood or paper cellulose commercial mulch materials compatible with hydroseeding operations. Mulch depth according to mulch manufacturers' recommendation. DO NOT use mulch of straw, pine needles, etc., because of their low moisture holding capacity.
 - b. Topsoil – needed only for seeding, recommended for hydroseeding: Obtain specified topsoil for a light "dusting" (no more than ½" or 13mm) above rings filled with sand for seeding germination.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine subgrade and base course installed conditions. Do not start porous paving installation until unsatisfactory conditions are corrected. Check for improperly compacted trenches, debris, and improper gradients.
- B. For fire lane installations: prior to installing base course for turf paving, obtain approval of local fire authorities of sub-base.

- C. Start of installation constitutes acceptance of existing conditions and responsibility for satisfactory performance. If existing conditions are found unsatisfactory, contact Architect for resolution.

3.2 PREPARATION

A. Subgrade Preparation:

1. Prepare subgrade as specified in Section 32 10 00. Verify subgrade in accordance with porous paving system manufacturer's instructions.
2. Proper subgrade preparation will enable the Porous Flexible Paving rolls/units to connect properly and remain level and stationary after installation.
3. Excavate area allowing for unit thickness, the engineered base depth (where required), and 0.5 inch (1.25 cm) for depth of sod root zone or topsoil germination area (when applicable). Provide adequate drainage from excavated area if area has potential to collect water, when working with in-place soils that have poor permeability. Ensure in-place soil is relatively dry and free from standing water. Uniformly grade base. Level and clear base of large objects, such as rocks and pieces of wood.

B. Base Preparation:

1. Install Base as specified in Section 32 10 00. Verify engineered base (if required) is installed in accordance with porous paving system manufacturer's instructions. If required, place a geotextile separation layer between the natural ground and the 'engineered base'. If required, install the specified sub-drain and outlet according to construction drawings. Place engineered base in lifts not to exceed 6 inches (150 mm), compacting each lift separately to 95 percent Modified Proctor. Leave 1 inch (2.5 cm) of depth below final grade for porous paver unit and sand fill and 0.5 inch (1.25 cm) for depth of sod root zone or topsoil germination area (when applicable).

3.3 ON-SITE MANUFACTURER'S FIELD REPRESENTATIVE

- A. A qualified Manufacturer's field representative shall be available for a pre-construction meeting via phone or in person and will provide installation videos, design details, installation instructions, and the technical specifications.

3.4 HYDROGROW INSTALLATION

- A. Spread all Hydrogrow mix provided (spreader rate = 4.53 kg per 100 m² (10 lbs per 1076 ft²) evenly over the surface of the base course with a hand-held, or wheeled, rotary spreader.
- B. The Hydrogrow mix should be placed immediately before installing the Porous Flexible Paving.

3.5 POROUS FLEXIBLE PAVING INSTALLATION

- A. Install the Porous Flexible Paving units by placing units with rings facing up, and using snap-fit connectors, pegs and holes, provided to maintain proper spacing and interlock the units. **Units placed on curves, slopes, and high traffic areas shall be anchored to the base course, using 40d common nails with fender washer, or other manufacturer recommended anchoring systems, as required to secure units in place.** Tops of rings shall be between 6 mm to 13 mm (0.25" to 0.5") below the surface of adjacent hard-surface pavements.
- B. Install sand in rings as they are laid in sections by "back-dumping" directly from a dump truck, or from buckets mounted on tractors, which then exit the site by driving over rings

already filled with sand. The sand is then spread laterally from the pile using flat bottomed shovels and/or wide "asphalt rakes" to fill the rings. A stiff bristled broom should be used for final "finishing" of the sand. The sand must be "compacted" by using water from hose, irrigation heads, or rainfall, with the finish grade no less than the top of rings and no more than 6 mm (0.25") above top of rings.

3.6 INSTALLATION OF GRASS

Grass coverage on the sand-filled rings must be completed within one week. Sand must be re-installed and leveled and Porous Flexible Paving checked for integrity if rings become exposed due to wind, rain, traffic, or other factors.

1. Preferred method: Hydroseeding/hydro-mulching - A combination of water, seed and fertilizer are homogeneously mixed in a purpose-built, truck-mounted tank. The seed mixture is sprayed onto the site at rates shown on plans and per hydroseeding manufacturer's recommendations. Coverage must be uniform and complete. Following germination of the seed, areas lacking germination larger than 20 cm x 20 cm (8" x 8") must be reseeded immediately. Seeded areas must be fertilized and kept moist during development of the turf plants.). DO NOT DRIVE ON SYSTEM: Hydroseeded/hydro-mulch areas must be protected from any traffic, other than emergency vehicles, for a period of 6 to 8 weeks, or until the root system has penetrated and established well below the Porous Flexible Paving units.
2. Install thin sod directly over sand filled rings, filled no higher than the top of the rings. Sod strips should be placed with very tight joints. Sodded areas must be fertilized and kept moist during root establishment (minimum of 3 weeks). DO NOT DRIVE ON SYSTEM: Sodded areas must be protected from any traffic, other than emergency vehicles, for a period of 3 to 4 weeks, or until the root system has penetrated and established well below the Porous Flexible Paving units.
3. Install grass seed at rates per grass type. A light "dusting" of commercial topsoil mix, not to exceed 1/2" (25 mm) will be placed above the rings and seed mix to aid germination rates. Seeded areas must be fertilized and kept moist during development of the turf plants.). DO NOT DRIVE ON SYSTEM: Seeded areas must be protected from any traffic, other than emergency vehicles, for a period of 6 to 8 weeks, or until the root system has penetrated and established well below the Porous Flexible Paving units.
- A. Adequately water sod or grass seed to assure germination of seed and growth of root system.

3.7 PROTECTION

- A. If Seeded, areas must be protected from any traffic, other than emergency vehicles, for a period of 4 to 8 weeks, or until the grass is mature to handle traffic.
- B. If Sodded, areas must be protected from any traffic, other than emergency vehicles, for a period of 3 to 4 weeks, or until the root system has penetrated below the Porous Flexible Paving units.

3.8 FIELD QUALITY CONTROL

- A. Remove and replace segments of Porous Flexible Paving units where three or more

adjacent rings are broken or damaged, reinstalling as specified, so no evidence of replacement is apparent.

- B. Perform cleaning during the installation of work and upon completion of the work. Remove all excess materials, debris, and equipment from site. Repair any damage to adjacent materials and surfaces resulting from installation of this work.

3.9 MAINTENANCE

- A. Maintain grass in accordance with manufacturer's instructions and as specified in Section 32 92 00 Lawns.
- B. Lawn Care: Normal turf care procedures should be followed, including de-thatching.
- C. DO NOT AERATE. Aerator will damage the Porous Flexible Paving units. Aeration is not necessary in a sand root zone.
- D. When snow removal is required, keep a metal edged plow blade a minimum of $\frac{3}{4}$ inch (17 mm) above the surface during plowing operations to avoid causing damage to the Porous Flexible Paving units, or
 1. Use a plow blade with a flexible rubber edge, or
 2. Use a plow blade with skids on the lower outside corners set so the plow blade does not come in contact with the units.

END OF SECTION 32 12 43

SECTION 321313

PORTLAND CEMENT CONCRETE PAVEMENT

PART 1 – GENERAL

- 1.1 **RELATED DOCUMENTS:** Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- 1.2 **RELATED SECTIONS**

Section 31 23 00: Earthwork.
Section 32 10 00: Roadway and Miscellaneous Subbase.
- 1.3 **WORK INCLUDED:** Construct Portland Cement sidewalk slabs and miscellaneous items as shown on the plans or as indicated.
- 1.4 **SUBMITTALS:** Contractor shall submit design mixes for all concrete products intended for use. Also submit detailed plan and necessary drawings for the Landscape Architect/Engineer's review and approval. Plan submitted shall indicate pour sequencing and incorporate specified time lag before pouring adjacent sections of concrete.
- 1.5 **SPECIAL CURING REQUIREMENTS:** The Contractor shall leave concrete forms in place a minimum of five (5) days after each pour. In addition, the Contractor shall moist cure the concrete during this period.
- 1.6 **APPLICABLE MATERIAL AND INSTALLATION STANDARDS**
 - A. American Society for Testing Materials:
 1. Specification for concrete aggregates.
 2. Method of test for soundness of aggregates by the use of sodium sulfate or magnesium sulfate.
 3. Specification for ready-mix concrete.
 4. Specification for Portland cement.
 5. Air-Entraining Portland cement.
 6. Test for scratch hardness of soft fragment particles.
 7. Air-entraining admixtures for concrete.
 8. Specification for preformed expansion joint fillers for concrete paving and structural construction (non-bituminous types).
 - B. American Concrete Institute:
 1. ACI 318 Building Code Requirements for Reinforced Concrete.
 2. ACI 604 Recommended Practice for Winter Concreting.
 3. ACI 605 Recommended Practice for Hot Weather Concreting.
 4. ACI 613 Recommended Practice for Selecting Proportions for Concrete.

5. ACI 614 Recommended Practice for Selecting Proportions for Structural Lightweight Concrete.
6. ACI 614 Recommended Practice for Measuring, Mixing and Placing Concrete.
7. ACI 315 Manual of Standard Practice for Detailing Reinforced Concrete Structures.
8. ACI 544 Manual of Concrete Practices for Fiber Reinforced Concrete.

PART 2 - PRODUCTS

2.1 CONCRETE: 4500 PSI compressive strength concrete at the end of 28 days.

Air Content: $6\% \pm 1\%$, W/C, = 0.38, batch with high-range water reducer.

Slump: 4-6" with high-range water reducer.

- A. Portland Cement: ASTM C150, Type 1, natural color. Minimum mix content 575 lbs/cy.
 - B. Fine Aggregate: ASTM C-33 except as noted below. Contain maximum of two percent (2%) by weight of the following: shale, schist, alkali, earth, loam, mica, coated grains, soft and flaky particles. No more than four percent (4) clay by volume. 95% pass No. 4 sieve. Less than 3 percent (3%) pass No. 100 sieve.
 - C. Coarse Aggregate: Crushed quarried stone, ASTM C-33. Aggregate Size No. 57.
- 2.2 WATER: Clean and free from oil, acid and injurious materials and amounts of vegetable matter, alkalis, and other salts.
- 2.3 WATER REDUCING AGENT: Shall be listed on the current approved list of the NYSDOT Materials Bureau.
- 2.4 AIR ENTRAINING AGENT: Shall be listed on the Current Approved List of the NYSDOT Materials Bureau.
- 2.5 Non-shrink grout shall be "EMBECO" as manufactured by Master Builders.
- 2.6 CONCRETE FORMS: Wood or metal designed to support concrete at time of placement, reinforcing, placement equipment and personnel involved during pouring and finishing operations. Form design shall provide for leak-proof joints. Include bracing and shoring required to prevent deflection of joints.
- 2.7 FORM TIES
- A. Exposed Concrete: Plastic cone snap-tie, similar and equal to Superior's Type 3M; with Superior's 1 inch concrete plugs, color to be selected.
 - B. Unexposed Concrete: Snap-off metal ties, designed to prevent form deflection, and prevent spalling surfaces upon removal. Portion remaining after removal shall be at least 1 inch from concrete surface.

- 2.8 FORM COATINGS: Commercial formulation form-coating compounds shall not bond with, stain, nor adversely affect concrete surfaces, and shall not impair subsequent treatments, nor impede wetting of surfaces to be cured with water or curing compound.
- 2.9 EXPANSION JOINT MATERIAL: 1/2" thick ASTM D994 pre-molded expansion joint filler strips; full slab depth, except top portion shall be removable after concrete placement to accommodate sealant placement.
- 2.10 JOINT SEALANT
- A. Premium grade, high performance, moisture cured, one component, polyurethane base, non-sag elastomeric sealant.
 - B. Federal Specification TT-S000230C, Type II, Class A.
 - C. Sikaflex 1A, as manufactured by the Sika Corporation, or approved equivalent.
- 2.11 CURING SHEET MATERIAL: ASTM C-171.
- 2.12 BACKER ROD: Sonofoam polyethylene foam by Sonneborn, or approved equivalent, unless otherwise instructed by the sealant manufacturer.
- 2.13 WELDED WIRE FABRIC: As indicated on Drawings

PART 3 - EXECUTION

- 3.1 The Contractor shall coordinate and schedule an independent testing laboratory 24 hours in advance of any concrete pours. The Contractor shall employ and pay for services for an independent testing laboratory to perform specified inspection and testing. It shall be the responsibility of the Contractor to schedule the concrete testing laboratory to be on site during all concrete pours. Reschedule planned concrete pours as necessary to ensure the on-site presence of the concrete testing laboratory. Caution: No concrete shall be installed without on-site testing by the concrete testing laboratory. The Contractor shall not be entitled to additional compensation for concrete which cannot be incorporated into the work due to the failure to schedule and have a concrete tester on site. The Contractor's independent testing laboratory shall be approved by the Landscape Architect and Construction Manager.
- 3.2 MIX PROPORTIONING
- A. The responsibility for selection of proportions to be submitted to meet the NYSDOT Specification shall be that of the concrete supplier.
 - B. The proportions of ingredients shall be such as to produce a mixture which can be satisfactorily placed and consolidated by the methods to be employed.

3.3 PRODUCTION

- A. Ready Mixed Concrete: Except as otherwise provided in these specifications, ready mixed concrete shall be batched, mixed, and transported in accordance with "Specifications for Ready Mixed Concrete" (ASTM C-94).
- B. Mixing Water Control:
 - 1. Concrete which arrives at the site with slump below that suitable for placement may be adjusted by the addition of water to increase slump provided that the maximum slump is not exceeded. Any addition of water to increase slump shall be followed by mixing of at least 30 revolutions of the drum.
 - 2. After adjustment to the proper slump, discharging shall be allowed for as long as the concrete retains its workability without the addition of water.

3.4 INSTALLATION

- A. Forms:
 - 1. Forms, cores, molds, etc. shall be constructed so that the finish concrete will conform to the shapes, lines, grades, and dimensions indicated on the drawings. All forms shall remain in place for a minimum of 120 hours after completion of all concrete work, including finish work.
 - 2. Slots, chases, recesses, inserts, keys and temporary openings:
 - a. Box out for all slots, chases, recesses, or openings as shown on the drawings and as required by the work of all other trades.
 - b. Build bulkheads with keys in walls and footings for stopping concrete. Keys shall be clean, reused or new chamfered 2 x 4's.
 - c. Box out for all temporary openings such as shafts, pipe spaces, etc., and build forms to seal up when and as required.
 - d. Build into concrete all inserts, anchors, PVC or metal reglets, ties, hangers, collars, sleeves, thimbles, sockets, nailing blocks, miscellaneous and ornamental iron as required to secure the work of other trades.
 - e. General - Ample opportunity and full cooperation shall be given to the various trades and other contractors to install their required embedded items. Suitable templates or instructions, or both, will be provided for setting such items as are not placed in the forms by the trades themselves. Openings in floor slabs shall be provided for pipes, ducts, etc., prior to or at the time of placing the form work. All embedded items shall be subject to inspection by the Landscape Architect. Engineer before concrete is placed.
- B. Preparation for Placing Concrete:
 - 1. Notify the Landscape Architect/ Engineer 24 hours in advance of the beginning of the following stages of work:
 - a. Final grade for slab bearing.
 - b. Pouring concrete slabs, foundations or walls.

- c. Schedule date and time of pour with Owner's concrete testing laboratory.
2. Remove water from excavations or forms before depositing concrete. Divert any water flow through proper side drains. Remove without washing over freshly deposited concrete, debris, foreign materials from form interiors, from mixing, conveying equipment inner surfaces.
3. Provide runways or other means for wheeled equipment to convey concrete to deposit points. Do not wheel equipment used to deposit concrete over reinforcement. Do not support runways on reinforcement.
4. Spray existing concrete surfaces with water to a surface saturated condition prior to pouring concrete.

C. Placing Concrete:

1. Re-tempered concrete shall not be allowed. Air-slaked or lumpy concrete shall not be used. The contents of the mixer shall be completely discharged before each new batch is loaded.
2. In form work, spade or vibrate thoroughly to ensure contact with concrete. Tamping shall be done with an internal mechanical vibrator. Vibrators shall not be used to move or flow concrete.
3. No honeycombed work will be accepted.
4. Vertical and/ or horizontal plumb bulkheads with keys shall be used at joints (locations shown on plans) for ending day's work and arranged at right angles to planes of stress and in areas of minimum shear. Provide waterstop(s) where watertightness is required as shown on the plans. Watertightness is required for structures designed to contain fluid.
5. Concrete shall be placed in lifts not to exceed 18 inches.
6. Continuous vibration shall be used with the interval of insertion not to exceed 18 inches in any direction.
7. Placing shall be performed so as to prevent the forming of cold and/or irregular joints.
8. No free fall of concrete over 4'-0" will be permitted.
9. Maximum concrete pours shall be as follows:

Slabs: 25' maximum dimension, 600 sq. ft. maximum area, maximum length to width ratio of 2.

Walls: 30' adjacent concrete shall not be placed for a period of five (5) days, unless otherwise indicated. Note requirements for leaving forms in place under paragraph 3.4.

3.5 CONSTRUCTION JOINTS, CONTROL JOINTS AND EXPANSION JOINTS

- A. All joints shall be formed and caulked joints made at such locations shown on plans as will least impair the strength of the structure, and as may be required by the Landscape Architect/Engineer.
- B. Furnish and install keying and supplementary reinforcement at each construction joint and stoppage. Install waterstops as shown on plans, as required for watertight structures or as

required by Landscape Architect/ Engineer.

- C. Before pouring next section, clean exposed reinforcement, clean and roughen exposed concrete and slush with neat cement grout.
- D. Install expansion joint material at all locations where new concrete is cast against existing structures, walls, etc. Install expansion joints at 20' intervals within all new walks and as shown on the Contract Drawings, other than the above noted structures, walls, etc.
- E. Construct control joints, in slabs, at the locations shown on the drawings or at 5 foot intervals in each direction.

3.6 TOLERANCES

- A. Unless otherwise indicated, all concrete work to be faced with other materials shall have a tolerance not to exceed 1/4" as measured on a ten-foot straight edge.
- B. If any concrete varies beyond tolerances indicated, Contractor may be required to grind it down at no extra cost. Ground surface may require surface treatment. Provide required treatment as ordered by Landscape Architect/ Engineer at Contractor's expense.

3.7 PATCHING CONCRETE

- A. Immediately after removal of forms, patch all holes including those at form ties, honeycombing, and other voids in concrete surfaces. Remove all fins and other projections on concrete surfaces.
- B. Wet the surface to be patched and patch with stiff mortar of one part Portland cement to two parts sand. All exposed surfaces: The cement portion shall be one part white Portland and one part regular cement. Sand shall pass #30 sieve. Permit patching grout, before use, to set 20 to 30 minutes and re-temper without adding additional water.
- C. Compact mortar thoroughly into place and screed it off a little higher than adjacent work and finish flush after initial set.
- D. Work that cannot be properly patched, in the opinion of the Landscape Architect/ Engineer, shall be rejected.

3.8 SLABS ON GRADE

- A. Construct structures as shown on the drawings. Include all material, forms, etc. required.
- B. Compacted porous fill shall be placed before installing concrete slabs which bear on the ground. See applicable specifications and details on plans. Place vapor barrier over gravel base as shown on plans.
- C. Upon the prepared base, place a monolithic concrete slab, reinforced as indicated.

3.9 CONCRETE FINISHING

- A. No concrete finishing operation shall be conducted while there is free water on the surface, and no dusting of cement, sand or cement-sand mixture is to be used to dry up the surface water on the concrete. Power finishing tools may be used except that area adjacent to electrical trench header ducts, vertical surfaces, electrical fittings, etc. shall be hand finished.
- B. All concrete slabs shall be, after finishing, true and level to within 1/8" of 10' unless indicated to have drainage slopes. Remedial action at the Contractor's expense may be required, at the Landscape Architect/ Engineer's discretion, for any slab not meeting the above standards.
- C. Should spalling occur in surface of concrete, the slab shall be removed and replaced at the Contractor's expense. Patching surface of the concrete after initial set has taken place will not be accepted.

3.10 SPECIFIC SLAB FINISHES

- A. All slabs shall receive the following preliminary finish:
 - 1. Bring the concrete to the correct level and, at the proper times, screed, darby and float with a magnesium float. Additional operations shall be applied as indicated.
- B. Broom Finish (Final): Provide a medium broom finish or as noted on the plans, where broom finish is scheduled.
- C. Trowel Finish (Final): All other slab surfaces: Immediately following floating, steel trowel, steel trowel a second time at the proper time for a dense, hard surface.

3.11 PROTECTION AND CURING

- A. General:
 - 1. The following rules are for the minimum requirements of protection only and the Contractor shall remain fully responsible to produce concrete which has not been weakened or injured on the surface by frost or freezing or by incomplete protection during hot weather.
 - 2. Protection shall consist of heating the materials, fully enclosing the concrete, and maintaining the temperature of the enclosure at not less than 50° F. for five (5) days.
 - 3. Aggregates and water shall be heated to not more than 140° F. and the concrete shall not be less than 50° F, nor more than 90° F. when deposited.
 - 4. Contractor shall provide adequate protection during hot weather against rapid drying and cold joints. Accelerating, retarding, or anti-freeze admixtures will not be permitted. Provide facilities necessary for moist curing.
 - 5. Prevent use of concrete for a period of five (5) days after installation.
 - 6. Forms shall be left in place a minimum of 120 hours after completion of each pour.

B. Cold Weather Concreting:

1. When placing concrete at or below a temperature of 40° F., or whenever atmospheric temperatures will probably fall below this limit within the next 24 hours and after placing concrete, the mixing water and aggregates shall be heated and the freshly placed concrete protected by adequate housing or covering and heating.
2. The Contractor shall have on the job ready to install adequate equipment for heating the materials and for maintaining the proper temperatures and atmospheric moisture for the freshly placed concrete, and for enclosing the work in accordance with the requirements specified herein. Do not use salamanders or open fires. Submit diagrams showing type of equipment to be used and how it will be placed in order to maintain proper temperatures required during cold weather concreting for approval of the Landscape Architect/ Engineer.
3. Either aggregates or water or both, as may be necessary, shall be heated with steam coils or other approved devices so that the average temperature of the concrete as it is deposited in a form shall fall within the limits specified herein. Aggregates containing frozen lumps shall be independently heated and no materials containing frozen lumps, ice or snow shall be allowed to enter the mixer.
4. Before placing the concrete in any form or on any surface, or around any reinforcement, heat shall be applied in such manner that ice or snow will be completely removed and the reinforcement will be at the same temperatures as the concrete being placed. No concrete shall be placed on a subgrade that is frozen or on one that contains frozen materials.
5. Concrete, when placed in the forms, shall have a temperature of not less than 70° F. and not above 80° F. Freshly placed concrete shall be maintained at a temperature of not less than 50° F. for five (5) days for normal concrete, and not less than 50° F. for three (3) days for high early strength concrete. Cooling of the concrete to outside temperatures shall not be at a rate faster than one (1) degree each hour for the first day, and two (2) degrees each hour thereafter.
6. The use of salts, chemicals, or other foreign materials in the mix to lower the freezing point of the concrete is prohibited.
7. Before concreting any section of a structure, the section shall be completely housed or enclosed in a manner that will ensure the maintenance of the specified temperatures. The housing shall be left in place for the curing period specified except that sections may be temporarily removed as required to accommodate the placing of column forms or concrete provided that they are replaced immediately after the form or concrete is in its final position.
8. A permanent temperature record shall be kept showing the date, hour, outside temperature, and temperatures at several points within the enclosure to show the most favorable and unfavorable condition to which the concrete is subjected. Thermometer readings will be taken at the start of the work in the morning and again in the late afternoon and the data so obtained shall be recorded in such manner that it will show the location of each reading and any conditions which might have an effect on the temperature. A copy of the temperature records shall be furnished to the Landscape Architect/ Engineer upon request.

C. Hot Weather Concreting:

1. Hot weather, for the purposes of this specification, shall be defined as 80° F. and rising, or 85° F. and falling.
2. During hot weather, Contractor shall plan for prompt placement by assuring an adequate number of personnel to handle and place concrete, and he shall provide adequate protection during finishing and during operations.
3. Forms, reinforcing subgrade should be sprinkled with cold water just prior to concrete placement.
4. Concrete with a temperature exceeding 90° F shall not be placed and an attempt shall be made to keep the concrete temperature well below 90° F. Contractor shall check the temperature of concrete just prior to placement and after placement. This information shall be recorded together with the location that the particular concrete was placed.
5. Cooling of concrete materials before mixing and during mixing using methods as recommended by the American Concrete Institute shall be adhered to.
6. Concrete shall be placed as soon as possible after mixing and/or delivery. On flat work, all finishing operations should be conducted promptly.
7. Protection and Curing: Exposed surfaces shall be protected from accelerated drying by using continuous water curing methods and surfaces shall be kept moist for at least 120 hours. On flat slab or other work exposed to wind or other evaporate conditions, surfaces shall be protected by wet sand or sisal-kraft paper. If water is used directly on new surfaces, the temperature of water should not be much cooler than the concrete.
8. Test of concrete conducted during hot weather shall be in accordance with latest ACI and PCA Standards and/or recommendations.
9. During hot weather, a log shall be kept indicating air temperature, weather condition, relative humidity, and temperature of concrete before and after placement. These tests shall be conducted at frequent intervals and as required by the Landscape Architect/Engineer.
10. Admixtures to delay setting time will not be permitted.

D. Curing:

1. Concrete shall be protected against loss of moisture, rapid drying, or temperature changes, mechanical injury, or injury from rain or flowing water for a period of seven (7) days. Concrete shall be maintained above 50° F., and in a moist condition during curing period.
2. Curing shall commence as soon as free water has disappeared from the surfaces after finishing. Curing of formed soffits of beams, girders, floor slabs, and similar surfaces shall be accomplished by moist curing with forms for full curing period.
3. Except where specified methods of curing are specified, curing may be accomplished by any one of the following methods:
 - a. Moist Curing: Surfaces shall be kept continuously wet by covering with burlap, mats, or sand, thoroughly saturated with water and covering kept wet by spraying or hosing. Place materials to provide complete surface coverage and lap all joints minimum 3 inches.
 - b. Impervious-Sheeting Curing: Surfaces shall be thoroughly wetted with a fine

spray of water and then covered with waterproof paper, polyethylene sheeting, or polyethylene coated waterproof paper. Edges and ends of sheeting shall be overlapped not less than 4" and securely cemented or taped to form a continuous cover. Sheeting shall be weighted down to prevent displacement and shall be repaired or replaced if torn, damaged, or removed during curing period. Under this curing method, the surface of the concrete shall at all times be covered with a water film. Spray concrete surface periodically to ensure that at no time will concrete cure under "dry" conditions.

4. Concrete curing of exposed floor slabs shall incorporate one of the two methods described above. Use of a concrete cure, seal agent is not acceptable for curing of exposed floor slabs or sidewalks. Use of this product for sealing and/or curing in other locations may be allowed at Landscape Architect/ Engineer's discretion.

3.12 CONCRETE TESTING STANDARDS (Testing Provided by Owner)

A. American Society for Testing Materials:

1. Method of making and curing concrete compression and flexure test specimens in the field.
2. Method of test for compressive strength of molded concrete cylinders.
3. Method of test for securing, preparing and testing specimens from hardened concrete for compressive and flexural strengths.
4. Method of test for weight per cubic foot, yield, content (gravimetric) of concrete.
5. Method of test for slump of Portland cement concrete.
6. Standard method for sampling fresh concrete.
7. Method of test for air content of freshly-mixed concrete by the volumetric method.
8. Method of making and curing concrete compression and flexure test specimens in the laboratory.
9. Method of test for air content of freshly mixed concrete by the pressure method.

3.13 CONCRETE TESTS

- A. During the progress of the work, compression test specimens shall be made and cured in accordance with the "Standard Method of Making and Curing Compression and Flexure Test Specimens in the Field" (ASTM Standard C-31). Not less than five specimens (2 for 7 day, 2 for 28 day tests and one spare specimen) shall be made for each test, nor less than one test for each 50 cubic yards of concrete of each class or fraction thereof placed in one day. Specimens shall be cured under laboratory conditions. Except that when, in the opinion of the Landscape Architect/ Engineer, there is a possibility of the surrounding air temperature falling below 40° F., and he may require additional specimens to be cured under job conditions. Cost for laboratory tests for compression test cylinders shall be borne by the Contractor.
- B. Specimens shall be tested in accordance with the standard method of test for compressive strength of molded cylinders (ASTM Standard C-39).
- C. Slump tests shall be conducted for each individual concrete batch or as frequently as may

be required to assure that no concrete shall have more than the required slump. All tests shall be conducted in the presence of the Landscape Architect/ Engineer or his representative. Tests shall be performed in accordance with ASTM requirements. Tolerance is $\pm 1/2$ ".

- D. Entrained air tests for air-entrained concrete shall be conducted every hour and/or as frequently as may be required to assure that the concrete shall contain the air content specified. All tests will be conducted in the presence of the Landscape Architect/ Engineer or his representative, and testing of each batch will be made by the same representative of the testing laboratory. Take tests at point of placement for pumped concrete.
- E. All cylinders, air content test, and slump tests shall be made by qualified personnel acceptable to the Landscape Architect/ Engineer.
- F. The standard age test shall be 28 days, but 7-day tests may be used provided that the relation between 7-day and 28-day strengths of the concrete is established by tests for materials and proportions used. In the event that 28-day tests fall below the compressive strengths called for in the specifications, the spare test cylinder shall be broken at 56 days as a final check.
- G. If the average strength of the laboratory-cured field cylinders for any portion of the structure falls below the compressive strengths called for in the specifications, the Engineer may require tests in accordance with the "Standard Methods of Securing, Preparing, and Testing Specimens of Hardened Concrete for Compressive Flexural Strength" (ASTM Standard C-42) or order load tests to be made on the portions of the building so affected. Costs for hardened concrete tests and load tests shall be borne by the Contractor.
- H. If the average strength of the laboratory-cured field cylinders falls below the compressive strength called for, the concrete covered by these tests shall be assumed as inadequate for the structure and the Landscape Architect/ Engineer may require that load tests be placed on the portions of the structure in question. Loading shall be in accordance with Section 203 of the ACI Building Code Requirements for Reinforced Concrete, and the method of loading and conducting the test shall be submitted in advance to the Engineer for his approval. If the tested portion of the structure does not fulfill the requirements of the test, it shall be deemed to have failed and shall be removed and replaced. The Engineer reserves the right to reject sub-standard concrete work as indicated by hardened concrete field cylinders regardless of the load tests.
- I. The laboratory shall furnish copies of all tests as follows:
 - Construction Manager..... 1 copy
 - Landscape Architect/ Engineer 1 copy
 - General Contractor 2 copies
 - Concrete Supplier 1 copy
- J. At the end of the week, the Contractor shall submit to the Landscape Architect/ Engineer a record showing the results of all slump and air tests made during the previous week. This record shall indicate the location in the project where this particular concrete was used.

3.14 EVALUATION AND ACCEPTANCE

- A. Evaluation: Test results of standard cylinders, molded, cured and tested according to ASTM C-31 and C-39, shall be evaluated separately for each concrete mix according to the "Recommended Practice for Evaluation of Compression Test Results of Field Concrete" (ACI 214).
- B. Acceptance: The criteria for acceptance of concrete shall be detailed in "Building Code Requirements for Reinforced Concrete" (ACI 318, Chapter 4, Paragraph 4.3).

END OF SECTION 321313

SECTION 32 18 00

SAFETY SURFACING

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall furnish all labor, materials, equipment and transportation required for the placement of poured-in-place rubber play surfacing throughout the playground. The surfacing shall be placed at all locations identified on the Contract Drawings to the indicated grades. Layout and design of color and pattern is to be installed per the contract drawings.

1.2 SUBMITTALS

- A. In accordance with the SUBMITTAL section of these specifications submit manufacturer's specification and detail sheets for all materials to be utilized under this section.
- B. The contractor shall submit shop drawings for surface layout of color and pattern for approval by Owner's Representative prior to installation.
- C. Field layout of color and pattern of surfacing to be approved by Owner's Representative prior to installation.
- D. Provide poured-in-place surface color samples for final color selection approval as required by the Owner's Representative.
- E. Post installation testing will be required by the Owner at the Contractors expense. An independent testing agency shall test to ensure a HIC of 800, contractor is responsible for removal and reinstallation if the test results do not conform.
- F. Submit copies of testing procedures and results performed by an independent testing source, which demonstrates compliance with CSPA and ASTM guidelines. Supplier must certify that safety surface depth provided meets or exceeds ASTM and ADA requirements as referenced within this specification and U.S. Consumer Product Safety Commission's Technical Guidelines for:
 - 1. "Recommendations – When tested in accordance with suggested test method in ASTM F355 procedure C; A Surface should not impact a peak acceleration in excess of 200G's to an instrumented ANSI head-form dropped on a surface from the maximum fall height as delineated in the standard specification for Impact Attenuation of surface Systems Under and Around Playground Equipment Designated F1292-91."
 - 2. The surface shall meet the Head Injury Criteria (HIC) of less than 1000. Lab test shall be performed at (3) temperatures per ASTM F1292/F355E

over concrete. Testing over aggregate will not be allowed.

- G. Supplier must provide copies of testing procedures and results (g-max and HIC score results) performed by independent testing source(s) which demonstrates compliance with C.P.S.C. Guidelines as referenced. Contractor shall submit test results for review and approval by the owner.
- H. Supplier must provide complete installation instructions.
- I. A certificate of insurance must be provided by the supplier which shall provide a coverage of products liability with limit of liability not less than \$1,000,000.00

1.3 REFERENCE STANDARDS

- A. ASTM F 1292-99 or 04 – Standard Specification for Impact Attenuation of Surfacing Materials Within the Use Zone of Playground Equipment.
- B. ASTM F 1487-01 – Standard Consumer Safety Performance Specification for Playground Equipment for Public Use.
- C. ASTM F 1951-99 – Standard Specifications for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.

1.4 QUALIFICATIONS

- A. For installation of the poured-in-place play surface the contractor shall have a minimum of five (5) years experience provide evidence of successful completion of twenty-five (25) like surfaces installed during the past five (5) years with names of clients and phone numbers.

1.5 GUARANTEE AND ACCEPTANCE/LIABILITY

- A. Safety surface shall be guaranteed against failure or defect during normal use and operation for a period of one year.
- B. Any defective elements or areas shall be replaced in part or whole by the Contractor at no cost to the owner.
- C. The Contractor and the manufacturer shall hold the Owner and Landscape Architect/Engineer harmless from any damages or liability resulting from negligent acts or omissions on the part of the Contractor or Manufacturer or improperly installed material.

PART 2 - MATERIALS

2.1 POURED-IN-PLACE-PLAY SURFACE

- A. Rubber Safety surface shall be:

1. "Perma-Play" by Pro-Techs Surfacing, LLC. 2072 Coon Road, Akron, OH 4432, (303) 576-6058. <https://pro-techssurfacing.com/>.
2. "Playbound" poured-in place by Surface America, PO Box 157, Williamsville, NY 14231, (716) 632-8413. www.surfaceamerica.com.
3. "Everguard" poured-in-place rubber as manufactured by Evergreen Surfacing Inc., 550 Main Street, Westbury, NY 11590, (516) 864-0550, www.everguardsurfacing.com.
4. Or Approved Equal.

Color Mix shall be selected by the Owner's Representative.

- B. Play surface shall meet or exceed current Consumer Product Safety Commission (CPSC) guidelines issued in 'A Handbook for Public Playground Safety' (latest edition) for the minimum potential fall height of the play equipment, current Disabilities Act Guidelines (ADA) and current American Society for Testing Materials (ASTM) F-1292-91 requirements.
1. The Base Mat shall be a monolithic poured-in-place cushioned pad, made from a blend of recycled styrene butyrene rubber (SBR) and a polyurethane binder or approved equal. The depth of the SBR mat shall be such that in conjunction with the specified top-wearing course the total resilient surface system shall provide the required absorbency for the maximum potential fall from the specified play equipment. (Refer to Playground Equipment list / specification). SBR shall be mixed with the binder in a ratio of 88% SBR to 12% binder by weight to achieve maximum resilience.
 2. The Top Surface shall be a monolithic poured-in-place top surface, ½" total thickness, made from a blend of ethylene propylene diene monomer (EPDM) colored rubber with THREE separate color zones. Each color zone shall include a custom combination of a minimum of three colors to be chosen by the owner's representative during the submittal process. Top surface shall have a tensile strength of two hundred (200) psi. The urethane binder shall be an aliphatic non-yellowing type.
 3. Poured-in-place surfacing shall be placed throughout the full extent of the play area unless otherwise noted. The total depth of poured-in-place surfacing shall sufficient to meet a HIC of not more than 800 at installation based on maximum fall height of play structure indicate on the plans and specifications.
 4. Prefabricated shock pads will not be considered equal.

PART 3 - EXECUTION

3.1 PROCEDURES

- A. The Contractor shall deliver, spread and compact or place safety surfaces to conform to the lines and grades shown on the Contract Drawings. All work shall be done in accordance with the manufacturer's installation recommendations for poured-in-place surfaces.
- B. The Base Mat for the Poured-in-Place Play Surface shall be installed in accordance with the manufacturer's instructions. The Base Mat shall exhibit a minimum installed 3 ½"-inch thickness necessary to provide the required absorbency for the maximum potential fall from the proposed play equipment. At playlot edges, place a board between the end of the poured-in-place base pour and the concrete edge and remove the board after the base has sufficiently cured. Pour the top course of poured-in-place surfacing and allow material to fill the void created by the board.
- C. The top surface shall be installed following installation of the cushion course, in accordance with the manufacturer's instructions. The minimum installed thickness of the top wearing course shall be ½-inch. The contractor is responsible for insuring that no foot traffic is allowed on the surface before the curing is complete.
- D. Any tests of materials shall be as ordered by the Owner's Representative and paid for by the Contractor regardless of results.
- E. All safety surface tiles and curbs shall be installed according to manufacturer's and/or suppliers recommendation and/or specifications on a concrete base. Locations and installation methods shall be as shown as determined by the Owner's Representative.

PART 4 – GUARANTEE AND ACCEPTANCE/LIABILITY

- 4.1 All structural elements safety surface shall be guaranteed against failure or defect during normal use and operation for the entire warrantee period as established by the manufacturer.
- 4.2 Safety surfacing shall be free of defects due to workmanship or material for a minimum of two (2) years from date of installation. Any defective elements shall be replaced in part or whole by the Contractor at no cost to the Owner.
- 4.3 The Contractor and the manufacturer shall hold the Owner and Owner's Representative harmless from any and all damages or liability resulting from negligent acts and omissions on the part of the Contractor or manufacturer, or resulting from defective parts, or improper resilient safety surface installation. Contractor shall be responsible for securing site from pedestrian traffic or vandalism while poured-in-place safety surface dries.

- 4.4 The Contractor is responsible for securing an independent third-party Certified Playground Safety Inspector to ensure ASTM and CPSC compliance. A certificate of compliance will be issued to the Owner prior to final inspection including drop testing for HIC and Gmax on safety surfacing before the play area is opened.

END OF SECTION 321800

SECTION 32 30 00

SITE IMPROVEMENTS

PART 1 – GENERAL

- 1.1 RELATED DOCUMENTS: Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- 1.2 WORK INCLUDED

Provide site improvements in the locations shown or as described herein, complete with anchorages and associated site work.
- 1.3 RELATED SECTIONS
 - A. SECTION 31 23 00 EARTHWORK.
 - B. SECTION 32 12 16 ASPHALT CONCRETE PAVING.
 - C. SECTION 32 13 13 PORTLAND CEMENT CONCRETE PAVEMENT.
 - D. SECTION 32 18 00 RUBBER SAFETY SURFACING.
- 1.4 SUBMITTALS
 - A. Contractor shall submit catalog information for the following site improvements:
 - 1. Benches.

PART 2 – PRODUCTS

- 2.1 BENCH
 - A. Model #PAR4051, Agora, as manufactured by Kompan, Inc. or approved equivalent.
 - 1. Color: TBD by Owner. Provide color samples.
 - 2. Material:
 - a. Seat and backrest: Siberian larch wood.
 - b. Armrest and support: hot dipped galvanized steel.
 - 3. Mounting: Surface mount per manufacturer's recommendations.

PART 3 – EXECUTION

- 3.1 Equipment shall be permanently installed in concrete anchorages or surface mounted per manufacturer's specifications.
- 3.2 Any site improvement materials which are constructed of steel and not galvanized or factory coated with a finish system shall be painted in the field in accordance with the manufacturer's specifications. Colors as noted above.

END OF SECTION 323000

SECTION 32 30 10
ATHLETIC APPURTENANCES

PART 1 – GENERAL

1.01 RELATED DOCUMENTS:

- A. The General Documents, as listed in the Table of Contents, and applicable parts of Division 1, General Requirements shall be included in and made a part of this Section.
- B. Examine all Drawings and all other Sections of the Specifications for requirements therein affecting the work of this trade.

1.02 SCOPE OF WORK:

- A. The work of this Section consists of furnishing and installing all athletic equipment and appurtenances as indicated on the Drawings and/or as specified herein and includes, but is not limited to, the following:
 - 1. Basketball Posts, Hoops & Nets.

1.03 RELATED WORK UNDER OTHER SECTIONS:

- A. SECTION 03 30 00 CAST-IN-PLACE CONCRETE.
- B. SECTION 32 91 13 SOIL PREPARATION AND SOIL MIXES.

1.04 EXAMINATION OF CONDITIONS:

- A. The Contractor shall fully inform himself of existing conditions of the site before submitting his bid, and shall be fully responsible for carrying out all site work required to fully and properly execute the work of the Contract, regardless of the conditions encountered in the actual work. No claim for extra compensation or extension of time will be allowed on account of actual conditions inconsistent with those assumed.
- B. Plans, surveys, measurements and dimensions under which the work is to be performed are believed to be correct to the best of the Owner's Representative's knowledge, but the Contractor shall have examined them for himself during the bidding period, as no allowance will be made for any errors or inaccuracies that may be found therein.

1.05 SCHEDULING:

- A. The Contractor shall submit to the Owner's Representative, for approval by the Owner's Representative, a progress schedule for all work as specified herein.

1.06 QUALITY ASSURANCE:

- A. All appurtenances shall be located as shown on the detail drawings and in accordance with Amateur Athletic Union (AAU), the National Federation of State High School Associations (NFHS), and the National Collegiate Athletic Association (NCAA), as amended to date.
- B. Materials and methods of construction shall comply with the following standards:
 - 1. ASTM: American Society for Testing and Materials.
 - 2. ANSI: American national Standards Institute.
 - 3. FS: Federal Specifications.
 - 4. IMI: International Masonry Institute.
 - 5. PCA: Portland Cement Association.
- C. Qualifications of Workers: Use adequate numbers of skilled workers who are trained in the necessary crafts and who are completely familiar with the specified requirements and methods needed for the proper performance of the work of this Section.
- D. Layout: After staking out the work, and before beginning final construction, obtain the Owner's Representative's approval for layout. Contractor shall make adjustments as determined by the Owner's Representative. The Owner's Representative may make adjustments to layout as is required to meet existing and proposed conditions without additional cost to the contract price.

1.07 SUBMITTALS:

- A. Shop Drawings and Product Information: Provide manufacturer's data and/ or shop drawings showing installation and limitations in use. Supply Certificates of Compliance for all materials required for fabrication and installation, certifying that each material item complies with, or exceeds, specific requirements.

PART 2 – PRODUCTS

2.01 BASKETBALL POLE, RIM, BACKBOARD AND NETS

- A. Model #PR98S Ultimate Adjustable Steel Backboard Playground Basketball System as manufactured by Bison, Inc. or approved equivalent.
 - 1. Pole: Minimum 6" square, 3/16" wall structural steel tube suitable for a minimum 20" diameter width and 48" in-ground installation. Pole shall be capped.
 - 2. Setback: System shall provide a minimum clearance from the front of pole to front of backboard of 50" at 10' rim height.

3. Steel Assembly Pole Finish: Black powder coat.
4. Steel Backboard: Formed and welded steel with a 42" x 60" rectangular playing surface.
5. Steel Backboard Supports: Welded 1 ½" x 2 ½" tubular members.
6. Skin: 12 ga. mild steel and rear structure shall be 7 ga. and 10 ga. steel. All edges of skin shall be formed in such a way as no shear edges are exposed.
7. Backboard Color: White polyester powder coated finish with official-size orange shooter's square.
8. Rim: Spring type assembly provided by a compression spring. Two (2) 5/8" dia. high strength steel rings welded together at a minimum of six (6) places.
9. Rim Height: Adjustable between 7 ½' and 10' by removable hand crank.
10. Rim Color: Orange powder coat finish.
11. Net Attachment: Continuous constructed of 3/16" x 1" steel with punched net attachment slots.
12. Net: Standard Nylon.
13. Warranty: Manufacturer shall provide lifetime limited functional warranty for all elements of the complete pole/backboard/rim system.

PART 3 – EXECUTION

- 3.01 Install all appurtenances in accordance with the Drawings and the manufacturer's instructions.
- 3.02 The Contractor shall be responsible for timing the delivery of all materials so as to minimize on-site storage time prior to installation. All stored materials must be protected from weather, careless handling and vandalism.

END OF SECTION 323010

SECTION 323113
CHAIN LINK FENCE

PART 1 - GENERAL

1.1 WORK INCLUDED:

- A. The Contractor shall provide all labor, materials and appurtenances necessary for the installation of a complete chain link fence systems and shall meet or exceed the standards of the Chain Link Fence Manufacturer's Institute, New York, NY except as otherwise indicated on the Drawings and as herein specified.
- B. The manufacturer shall supply a total vinyl PVC coated chain link fence system of the height, fabric type, fabric gauge, framework strength, color and coating specifications contained herein. All fence materials unless specifically stated otherwise, shall be extrusion bonded polyvinyl chloride (PVC) coated.

1.2 RELATED WORK:

- A. Section 01 33 23, SUBMITTALS

1.3 REFERENCES:

- A. The following standards form a part of this specification as referenced.

American Society for Testing and Materials (ASTM)

ASTM	A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM	A121	Zinc-Coated (Galvanized) Steel Barbed Wire
ASTM	A392	Zinc Coated Steel Chain Link Fence Fabric
ASTM	A123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM	A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM	F567	Installation of Chain Link Fence
ASTM	F626	Fence Fittings
ASTM	F668	Specification for Poly Vinyl Chloride (PVC) - Coated Steel Chain-Link Fence Fabric.

ASTM F1043 Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework.

Federal Specifications (FS)

FS RR-F-191 Fencing Wire and Post, Metal (and Gates, Chain-Link Fabric, and Accessories)

1.4 SUBMITTALS: IN ACCORDANCE WITH REQUIREMENTS OF SECTION 01 33 23 SUBMITTALS, SUBMIT THE FOLLOWING:

- A. Manufacturer's literature of the materials specified herein.
- B. Shop drawings of the fence and the proposed color.

1.5 WARRANTY:

- A. Prior to installation, the fence contractor shall provide the fence manufacturer's notarized certification that all vinyl components are fully warranted by the manufacturer for 15 years against rust and corrosion.

PART 2 - PRODUCTS - PVC COATED

2.1 STEEL FRAMEWORK (GENERAL):

- A. All posts, gate frames, braces and horizontal rails shall be Type I round post, hot dipped galvanized with a minimum average coating of 1.8 oz/ft², meeting ASTM F 1083 for Standard Weight Galvanized Pipe and shall be of the sizes and weights given below or other approved equivalent sections of steel having a minimum tensile strength of 50,000 pounds per square inch and a minimum yield strength of 25,000 pounds per square inch.
- B. Minimum cross-section dimensions for line posts of specified shape shall be: either 2-3/8-inch (2.375-inch) outside diameter steel pipe weighing not less than 3.65 pounds per linear foot; or 2.25 by 1.95 by 9/64-inch steel H section weighing not less than 4.10 pounds per linear foot.
- C. Minimum cross-section dimensions for end, corner, and pull posts of specified shape shall be: 2-7/8-in. (2.875-in.) outside diameter steel pipe weighing not less than 5.79 pounds per linear foot; 2-1/2 by 2-1/2-inch square tubes weighing not less than 5.70 pounds per linear foot; or 3-1/2 by 3-1/2-inch rolled-formed sections weighing not less than 8.14 pounds per linear foot.
- D. All tubular and pipe posts shall be capped to prevent precipitation from entering the post, unless a barbed wire extension arm assembly acts as a cap.
- E. Posts, other fence framework, accessories, fittings, and miscellaneous items shall be galvanized and have an extrusion bonded polyvinyl chloride (PVC) coating. The PVC coating on posts shall be a minimum of 10 mils thick. Framework color coating shall match

fabric. Galvanized finish shall have not less than the following weight of zinc per square foot:

1. Pipe: 1.8 oz, complying with ASTM A53.
2. H-sections and square tubing: 2.0 oz, complying with ASTM A123.
3. Hardware and accessories: Comply with Table I of ASTM A153.

- F. For top railings and top, middle and bottom braces between terminal posts and adjacent lines posts, the minimum cross-section dimensions for the specified shall be 1-5/8-inch outside diameter steel pipe weighing not less than 2.26 pounds per linear foot.
- G. Diagonal truss braces between terminal and adjacent line posts and for gauge framework shall not be less than either 3/8-inch diameter steel rod or double No. 9 AWG steel wire stranded together.
- H. Fittings shall be galvanized press steel, malleable or cast steel as specified in ASTM F626 and Federal Specification RR-F-191.
- I. Where posts do not have provisions for weaving fence fabric to posts, tension or stretcher bars for attaching fabric to terminal posts such as end, corner, gauge and pull posts, shall be flat bar with nominal dimensions no less than 3/16 by 3/4-inch for use with fence fabric having mesh larger than 1-inch, of a length equal to full height of the fence fabric, and used with bar bands, bolts and nuts. Bar bands shall be no thinner than No. 11 gauge coated sheet steel. Bolt diameters shall be not less than 3/8-inch for use with bar bands.
- J. Ties for fastening fence fabric to line posts and rails shall be not less than No. 9 AWG steel wire with the same coating as the fence fabric or other approved bands.

2.2 CHAIN LINK FENCE FABRIC – PVC COATED:

- A. Vinyl coated fabric shall be supplied with Class 2A (extrusion bonded) vinyl coating. The coating shall be applied over a galvanized steel core wire and be manufactured in accordance with Federal Specifications RR-F-191 and ASTM F668. The PVC coating shall have a final coating thickness of 0.015-0.025-inch and a core wire size diameter of 0.148-inch.
- B. Wire size: The finished wire size shall be 6 gauge.
- C. Height and Mesh Size: The fabric height shall be 4-feet high with a mesh size of 2-inches.
- D. Selvage: Top edge and bottom edge of the fabric shall be twisted. Top edge of the fabric shall be knuckled.
- E. The tension wires shall be No. 7 gauge steel-core wire. PVC coating shall conform to ASTM F668 Class 2a or 2b. Also, a 7-strand galvanized steel 1/2-inch guy wire with PVC coating may be supplied.

- F. The polyvinyl chloride (PVC) coating shall be free of voids, shall be dense and impervious, shall be of a plasticized or epoxy modified, high specific gravity polyvinyl chloride with high resistance to tear and suitable hardness. The PVC coating shall not support combustion and shall withstand an accelerated aging and weathering test a minimum of 2,000 hours at 145 degrees F with ultraviolet and salt spray without cracking or peeling the PVC coating and without corrosion of the base metal. The PVC coating shall withstand a mandrel bending test of ten times the thickness of the base metal at minus 25 degrees F without cracking. The PVC coating shall not separate from the metal or shrink. Color used in PVC coating shall be stabilized so that it will not fade under long exposure to sunlight. Color shall be approved by the Engineer as selected from the manufacturer's standard colors.

2.3 SWING GATES – PVC COATED:

- A. Gate leaf frames shall be amply braced and trussed for rigidity. Truss rods shall be adjustable. Gate leaf framework shall be pipe or other approved suitable cross-section of the size recommended by the fencing manufacturer for the size of gate leaf, but shall be no smaller than 1-7/8-inch (1.875-inch) outside diameter steel pipe weighing not less than 2.72 pounds per linear foot. If bolted or riveted corner fittings are not used, the gate frame shall have the corrosion-resistant finish applied after welding.
- B. Gates, gate posts, fabric and associated hardware shall be thermally coated with PVC, 10 mils thick, to match the fence.
- C. Gate hinges shall be 180 degree, heavy pattern, of adequate strength for the gate size, with large bearing surfaces for clamping or bolting in position, and with hinge action such that the gates may be opened and closed easily.
- D. Gates shall be provided with accessible, suitable latches and provisions for padlocking.
- E. Double leaf gates shall have center bolts and center stops. Unless indicated otherwise on the drawings, the gates shall have automatic backstops to hold the leaves in open position.
- F. For gate openings, up to and including 12-feet, with double leaf gates, minimum cross-section dimensions for the gate posts of specified shape shall be the same as specified above for end posts.
- G. For gate openings larger than 12 feet, the minimum outside diameter for the gate posts shall be 6-5/8-inches, weighing not less than 18.97 pounds per linear foot.

PART 3 - EXECUTION

3.1 ERECTION:

- A. The fence and gates shall be erected by skilled mechanics in accordance with the recommendations of the manufacturer and these specifications. These specifications shall take precedence over the recommendations of the manufacturer if any discrepancy exists between them.

- B. Maximum post spacing shall be 10-feet. Post spacing shall be uniform and posts shall be plumb. All end, corner, pull, line and gate posts must be set in concrete.
- C. Concrete post foundations in earth shall be concrete cylinders with a minimum diameter of 12-inches, crowned at grade to shed water, and shall extend not less than 3-feet into the ground. Posts shall be set in the full depth of the foundations except for 3-inches of concrete under the posts. If foundation holes are excavated in unsuitable material, the Engineer shall be notified for determination of suitable construction precautions.
- D. If solid rock is encountered without an overburden of soil, poles shall be set into the rock a minimum depth of 12-inches for line posts and 18-inches for terminal posts, such as end, corner, gate and pull posts, and grouted into solid rock with the post hole diameter a minimum of one inch larger than that of the post.
- E. Where solid rock is covered by an overburden of soil or loose rock, the posts shall be set into the rock as specified above. The total pole setting depth shall not exceed the depths required for setting in earth.
- F. Any change in direction of fence line of 30 degrees or more shall be considered as a corner. Pull posts shall be used at all abrupt changes in grade. Maximum area of unbraced fence shall not exceed 1,500 square feet.
- G. Terminal posts such as end, corner, gate and pull posts shall be braced to the adjacent post(s) with horizontal rail braces used as compression members and diagonal truss braces with truss tighteners for tension members, with the lower ends at the terminal post in each panel of fence framework as indicated in detail on drawings.
- H. The top railing shall pass through intermediate or line post tops, form a continuous brace with all splices made by approved couplings, and shall be fastened to terminal posts.
- I. Fabric shall be stretched taut, with the bottom edge following the finished grade, and shall be a continuous mesh between terminal posts. Each span of fabric shall be attached independently at terminal posts. Where terminal posts do not have provisions for weaving fabric to posts, stretcher bars shall be placed through the end weave of the fabric and secured to the post with bar bands spaced not more than 15-inches apart on the post.
- J. Fabric shall be attached with ties to line posts at intervals of not more than 14-inches (and to the top railing and braces at intervals not exceeding 24-inches).
- K. The bottom tension wire shall be interlaced in the weave of the fabric, pulled taut and fastened to terminal posts.

END OF SECTION 323113

SECTION 329113

SOIL PREPARATION AND SOIL MIXES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Work Included in this Contract:

1. Screening, spreading and amending native topsoil as required from on-site stockpiles.
2. Furnishing topsoil from an off-site source, screening, and spreading, if needed.
3. Seed bed preparation.

B. Related Sections:

Section 02 30 00: Soil Testing Services.
Section 31 23 00: Earthwork.
Section 31 11 00: Clearing and Grubbing.
Section 31 23 16: Trenching, Backfilling and Compaction.
Section 31 25 00: Sediment and Erosion Control.

1.2 QUALITY ASSURANCE

A. Testing Laboratory: Provided by Contractor. Refer to Section 023000.

B. Reference Standards: NYSDOT Specifications.

1.3 SUBMITTALS

A. Certificates: Manufacturers' or suppliers' certification that content of materials meets specification requirements.

1. Fertilizer.
2. Lime (if required).
3. Off-site topsoil.
4. Compost.

B. Test Reports: Supply Soil Testing Reports for topsoil to be used for turf areas.

1.4 DELIVERY, STORAGE AND HANDLING

A. Fertilizer and lime: Deliver to site in unopened, undamaged containers.

B. Store fertilizer and lime materials so they are protected from all forms of moisture such as rain, snow, surface drainage, ground water, condensation, etc.

C. Do not use wet, mildewed or caked material.

1.5 PROJECT CONDITIONS

- A. Environmental requirements: Do not prepare or place frozen soils or soils in a muddy condition. Do not spread topsoil on frozen or muddy subsoil.
- B. Protection: Protect other parts of this Contract from damage.

PART 2 - PRODUCTS

2.1 MATERIAL-TOPSOIL

- A. Native topsoil: from on-site stockpiles.

- 1. General Lawn Areas: Screen topsoil to meet the following gradation:

<u>SIEVE SIZES</u>	<u>PERCENT PASSING BY WEIGHT</u>
2 inch	100
1 inch	85 to 100
1/4 inch	65 to 100
No. 200 Mesh	20 to 50

- 2. Turf Areas: Amend the soil to meet the same specifications as off-site topsoil.

- B. Off-site topsoil:

- 1. The surface layer of dark colored humus soil, free from refuse, any material toxic to plant growth, subsoil, woody vegetation, stumps, roots, brush, stones, clay lumps or similar objects larger in greatest dimension than specified below. Sod and herbaceous growth such as grass and weeds shall be thoroughly broken up and mixed with the soil.
- 2. pH: between 5.5 and 7.6.
- 3. Organic content: Not less than 2 % or more than 8%.
- 4. Gradation:

<u>SIEVE SIZES</u>	<u>PERCENT PASSING BY WEIGHT</u>
2 inch	100
1 inch	85 to 100
1/4 inch	65 to 100
No. 200 Mesh	20 to 50

2.2 MIXES

- A. Lawn Fertilizer: Available nutrients, percent by total weight.

- 1. 9 nitrogen-at least 50 % from organic source.
- 2. 23 phosphorus.
- 3. 14 potassium.
- 4. Must contain a pre-emergent crabgrass control.

- B. Limestone: Ground limestone with a minimum total neutralizing value of 88 % calcium carbonate equivalence, minimum 90 % passing the 20 mesh sieve and minimum 60 % passing the 100 mesh sieve.

- C. Compost shall contain organic matter or material of a generally humus nature capable of sustaining the growth of vegetation, with no "foreign" matter (i.e. glass, plastic, etc.) or material toxic to plant growth. It shall be free from stones, lumps or similar objects larger than two inches in greatest diameter, roots, and brush. Composts that have been derived from organic wastes such as food and agriculture residues, animal manures and sewage sludge that meet the above requirements and are approved by the State Environmental Agency are acceptable compost sources.

Compost for USE ON TURF shall have the following properties:

<u>Parameters</u>	<u>Range</u>
pH	5.5 - 8.5
Moisture content	35% - 55%
Particle Size	<1/2"
C:N ratio	15 - 30:1

- D. Water:

1. Water used during the installation, "grow-in", and Maintenance period shall be provided and paid for by the Contractor. The Sports Field Contractor shall be responsible for appropriate water application. Water utilized shall be suitable for irrigation and free from ingredients harmful to plant life.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas to receive soil preparation to assure work of other trades has been completed.
- B. Remove jute mesh, staples, hay bales and other erosion control measures in the line of work.
- C. Completely disc subsoil that has become compacted and re-grade to required subgrade.
- D. Verify that all subsoils are positively drained and free of ponded areas and debris.
- E. Perform topsoil analysis for pH with recommendations for adjustment to specified pH limits.
- F. Do not proceed with soil preparation until unsatisfactory conditions are corrected.

3.2 PREPARATION

- A. If the subsoil has become overly compacted after discing, in the opinion of the Engineer, just prior to placing the topsoil, the subsoil material shall be scarified to a minimum depth of 3 inches so as to ensure a proper bond between the subsoil material and the topsoil.
- B. Screen topsoil to remove particles larger than 3/4".

3.3 INSTALLATION

- A. Topsoil:
 - 1. Spread topsoil on all disturbed areas within Contract Limit Lines to a depth of 6 inches as shown on plans.
 - 2. Import topsoil if stockpiled topsoil is insufficient to attain specified depth.
 - 3. Fine rake topsoil to break up lumps and remove stones, debris, and foreign material one inch or larger in any dimension, and to establish a smooth uniform surface.
 - 4. Final grades shall not vary more than one-tenth of a foot from elevations shown on Contract Drawings.
 - 5. No unsightly variations, bumps, ridges, or other depressions which will hold water shall be acceptable.
- B. Fertilization:
 - 1. Apply fertilizer at a rate of 500 pounds per acre, or roughly 11.5 pounds per thousand square feet to all topsoil.
 - 2. Lightly work fertilizer into the topsoil.
- C. Liming:
 - 1. Based on laboratory analysis and recommendations. Adjust pH of all areas to be between 5.5 pH and 6.5 pH, as follows:

Existing pH, less than 4.0	170 lbs./1000 SF
4.1 - 4.5	155 lbs./1000 SF
4.6 - 5.0	125 lbs./1000 SF
5.1 - 5.5	95 lbs./1000 SF
- D. Compaction:
 - 1. Exercise extreme caution in all topsoil areas that soil is not overly compacted.
 - 2. Soil that has become overly compacted, in the judgment of the Architect, shall be re-worked to achieve a satisfactory condition at no additional cost.
 - 3. Topsoil on sloped areas may be lightly rolled to prevent erosion if application of seed is delayed.

3.4 CLEAN-UP

- A. Immediately clean up spills of soil and conditioners on paved and finished surface areas.
- B. Remove debris and excess materials from project site.

3.5 STOCKPILES

- A. Hydroseed excess topsoil remaining in stockpiles. Do not remove excess topsoil from Owner's property. Coordinate with school on spreading out excess topsoil, prior to hydroseeding.

END OF SECTION 329113

SECTION 329200

LAWNS

PART 1 – GENERAL

- 1.1 RELATED DOCUMENTS: Drawings and general provisions of Contract, including General and supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- 1.2 WORK INCLUDED
 - A. Application of seed and mulch by broadcasting.
 - B. Application of seed and mulch by mechanical means.
 - C. Application of seed and mulch by hydroseeding.
 - D. Establish dense lawn to the satisfaction of the Landscape Architect.
 - E. Repair all unestablished lawns.
- 1.3 RELATED SECTIONS
 - Section 31 23 00: Earthwork.
 - Section 31 23 16: Trenching, Backfilling and Compaction
 - Section 32 91 13: Soil Preparation and Soil Mixes.
- 1.4 QUALITY ASSURANCE
 - A. Reference Standards: NYSDOT Specifications.
 - B. Source Quality Control: Producer's tests for purity and germination of seed, dated within nine months of application.
- 1.5 SUBMITTALS
 - A. Manufacturer's or supplier's certification that materials meet specification requirements.
 - B. Certification of grass seed from seed vendor for each grass-seed mixture stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
 - 1. Certification of each seed mixture for sod, identifying sod source including name and telephone number of supplier. (where applicable)
 - 2. Certification by product manufacturer that the following products supplied comply with requirements:
 - a. Limestone.
 - b. Fertilizers.

- C. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and address of Landscape Architect/ Owners, and other information specified.
- D. Material test reports from qualified independent testing agency indicating and interpreting test results relative to compliance of the following materials with requirements indicated.
 - 1. Analysis of existing surface soil.
 - 2. Analysis of imported topsoil.
 - 3. Analysis of pH of subbase soil and topsoil, (Native and/or Imported).
 - 4. Analysis of chemical composition of subbase soil and topsoil.
- E. Planting schedule indicating anticipated dates and locations for each type of planting.
- F. Maintenance instructions recommending procedures to be established by Owner for maintenance of landscaping during an entire year. Submit before expiration of required maintenance periods.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful grass establishment. The installer shall have specific experience with the installation of athletic field sod.
 - 1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during times that grass planting is in progress.
- B. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to Landscape Architect's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.
- C. Topsoil and subbase soil analysis: Furnish a soil analysis made by a qualified independent soil-testing agency stating percentages of organic matter, inorganic matter (silt, clay, and sand), deleterious material, pH, and mineral and plant-nutrient content of topsoil.
 - 1. Report suitability of topsoil for lawn growth and sod growth. State recommended quantities of nitrogen, phosphorus, and potash nutrients and any limestone, aluminum sulfate, or other soil amendments to be added to produce a satisfactory topsoil capable of supporting growth of lawns.
 - 2. Testing shall be performed at a rate of one (1) test per ten thousand (10,000) square feet for lawns and athletic fields.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Seed, Hydroseed Mulch and Binder: Deliver to site in unopened, undamaged containers.
- B. Store materials so they are protected from all forms of moisture such as rain, snow, surface drainage, ground water, condensation, etc.

- C. Do not use wet or mildewed materials.

1.8 PROJECT CONDITIONS

- A. Existing Conditions: Apply seed only after preceding work affecting ground surface is complete.
- B. Environmental Requirements:
 - 1. Do not apply seed when soil is in a frozen, muddy or overly compacted condition.
 - 2. Do not apply seed when wind exceeds 5 mph.
 - 3. Time of seed application:
 - a. August 15 through September 30.
 - b. April 1 through May 15.
 - c. These periods may be extended or reduced according to prevailing weather conditions, upon approval by the Landscape Architect.
- C. Protection: Restrict foot and vehicular traffic from seeding areas after application of seed and mulch until the end of establishment period.

1.9 MAINTENANCE

- A. Begin maintenance of lawns immediately after each area is planted and continue until acceptable lawn is established, but for not less than the following periods:
 - 1. Seeded Lawns: 60 days after date of Substantial Completion.
 - a. When full maintenance period has not elapsed before end of planting season, or if lawn is not fully established at that time, continue maintenance during next planting season.
- B. Maintain and establish lawns by watering, fertilizing, weeding, mowing, trimming, replanting, and other operations. Roll, re-grade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth lawn. Sodded areas which die shall be replaced with new sod.
 - 1. Replant bare areas with same materials specified for lawns.
 - 2. Add new mulch in areas where mulch has been disturbed by wind or maintenance operations sufficiently to nullify its purpose. Anchor as required to prevent displacement.
- C. Watering: Provide and maintain temporary piping, hoses, and lawn-watering equipment to convey water from sources and to keep lawns uniformly moist to a depth of 4 inches.
 - 1. Lay out temporary lawn-watering system and arrange watering schedule to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly seeded, plugged, or sprigged areas.
 - 2. Water lawn at the minimum rate of 1 inch (25 mm) per week.
- D. Mow lawns as soon as there is enough top growth to cut with mower set at specified height for principal species planted. Repeat mowing as required to maintain specified

height without cutting more than 40 percent of the grass height. Remove no more than 40 percent of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain following grass height:

1. Mow grass to a height of 2 inches when the overall height reaches 3 to 4 inches.

E. Post-fertilization: Apply fertilizer to lawn after first mowing and when grass is dry.

1. Use fertilizer that will provide actual nitrogen of at least 1 lb. per 1000 sq. ft. of lawn area.

PART 2 - PRODUCTS

2.1 Seed: Fresh, clean, new crop seed, weed content not exceeding 0.03 percent. It shall conform to Federal and State Standards. Each type of seed in the mixture shall meet or exceed the minimum percentage of purity and germination listed for that type of seed.

2.2 Mulching shall consist of paper or wood cellulose fibers, processed to contain no growth- or germination-inhibiting factors and dyed an appropriate color to facilitate visual metering of the materials application. The mulch material shall be supplied in packages having a maximum gross weight of 100 pounds. The mulch will have a maximum 10% moisture content, air dry weight basis.

2.3 The binder material shall be a biodegradable type as manufactured under the trade names of TERRATAK or CURASOL or equal. The manufacturer's suggestions for storage, mixing, and application shall be strictly adhered to and the Landscape Architect may sample the binder for testing purposes at any time. Other binders may be used if it can be demonstrated to the Landscape Architect's satisfaction that they are at least equal to the binders mentioned in all respects.

2.4 Straw mulch shall be stalks of oats, wheat, rye or other acceptable herbaceous growth that is free of noxious weeds. Materials that are low grade and unfit for farm use, such as "U.S. Sample Grade" will be acceptable. Hay will not be used.

2.5 Chemical Binder: Conform to Item 713-12 of Reference Standards.

2.6 All water used shall be potable.

2.7 FERTILIZER

A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast-and slow-release nitrogen, 50 percent derived from natural organic sources of urea-form, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts of starter fertilizer recommended in soil reports from a qualified soil-testing agency to facilitate plant growth. Fertilizer shall have a ratio of 1 part nitrogen; 2 parts phosphorous; 1 part potassium, and shall be 12-24-12 or comparable fertilizer.

2.8 MIXES

A. Seed:

1. Seed shall be a mixture of the species specified mixed in the proportion as listed below:

- a. "Lawn Mix" (Lawn Mix A) (For use on disturbed/damaged lawns)

SPECIES	PERCENT BY WEIGHT	GERMINATION	PURITY
Rebel II or Rebel III Tall Fescue (or equivalent)	30	95%	80%
Relient Hard Fescue (or equivalent)	15	95%	80%
Baron Kentucky Bluegrass (or equivalent)	25	85%	75%
Palmer II or Prelude II Perennial Ryegrass (or equivalent)	30	95%	85%

- B. Tall Fescue variety shall provide heat and drought tolerance and produce leaves which are up to 30% finer and 188% denser than the standard Kentucky 31 Tall Fescue.
 - C. Perennial Ryegrass variety shall provide heat and drought tolerance and produce a leafy turf-type, fine textured, low growing turf of a dark green color.
 - D. Hard Fescue variety shall produce dark green, fine textured turf under minimal maintenance, especially where the use of fertilizer is discouraged or banned.
 - E. That portion of the above mixtures listed as inert and other shall consist of non-viable seed, chaff, hulls, live seeds of crop plants and harmless inert matter.
 - F. All seed mixtures shall be mixed by the vendor and shall be delivered in standard sized bags of the vendor, showing the weight, analysis, and vendor's name.
 - G. If the Contractor feels a different seed mixture will perform better within the zone specified, he may submit on such a mix.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Check that preceding work affecting ground surface is complete.
 - B. Verify that soil is unfrozen and within acceptable range of moisture content.
 - C. Do not start until conditions are satisfactory.

3.2 PLANTING SOIL PREPARATION

- A. Limit subgrade preparation to areas that will be planted in the immediate future.

- B. Preparation of Unchanged Grades: Where lawns are to be planted in areas unaltered or undisturbed by excavating, grading, or surface soil stripping operations, prepare soil as follows:
1. Remove and dispose of existing grass, vegetation, and turf. Do not turn over into soil being prepared for lawns.
 2. Till surface soil to a depth of at least 6 inches. Apply required soil amendments and initial fertilizers and mix thoroughly into top 4 inches of soil. Trim high areas and fill in depressions. Till soil to a homogenous mixture of fine texture.
 3. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth.
 4. Remove water material, including grass, vegetation, and turf, and legally dispose of it off the Owner's property.
- C. Grade lawn and grass areas to a smooth, even surface with loose, uniformly fine texture lightly. Roll and rake to provide a firm surface, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas that can be planted in the immediate future. Remove trash, debris, stones larger than 1-1/2 inches in any dimension, and other objects that may interfere with planting or maintenance operations. Do not compact soils within athletic fields. (Compaction within athletic field areas should be at a minimum 80% and maximum 85%) The soil should be lightly rolled with a one (1) ton maximum non-vibratory roller. Roll the subgrade at a 45° horizontal angle to the proposed direction of sod placement, followed by a 2nd pass rolled at 90° to the first pass.

3.3 APPLICATION

- A. Apply seed at the rate of six pounds per 1000 square feet.
- B. Hydroseeding:
1. Mechanically agitate the required materials to form a homogeneous slurry. Spray the slurry on the ground by a hydraulic seeder equipped to apply up to 200 gallons per minute at 100 pounds pressure from the nozzle with a clearance for 1/2 inch solids.
 2. When hydraulically sprayed on the ground, the material shall form a blotter-like cover impregnated uniformly with grass seed. The cover will allow the absorption of moisture and allow rainfall or added water to percolate to the underlying soil.
 3. The suggestions of the manufacturer of the individual materials shall be followed in preparing and applying this hydroseeding mixture.
However, the following minimum ingredient amounts shall be used and thoroughly and consecutively mixed together.
Water as per manufacturer's instructions.
Seed as specified.
Biodegradable Binder as per manufacturer's directions.
Fiber Mulch 27.5 lbs./1000 square feet.
 4. Only use biodegradable binder on slopes greater than 4 horizontal on 1 vertical.
 5. All containers and tanks used for holding and mixing the ingredients and the final homogeneous hydroseeding mixture shall have been thoroughly cleaned of all material incompatible with seed germination and which is not readily biodegradable.

C. Broadcast Seeding:

1. Uniformly broadcast seed on prepared seed bed and immediately rake into top one half inch of topsoil. Do not displace seed during raking.
2. Immediately following seeding and raking, roll seed bed with a 200 pound roller and thoroughly water with a fine spray.
3. Immediately following rolling and watering, apply straw mulch uniformly to seed bed at rate of three tons per acre.
4. Uniformly apply binder to all mulch (slopes steeper than 4 horizontal on 1 vertical) at the following rates:
 - a. Chemical Binder: At manufacturer's recommended rate, or
 - b. Asphalt Emulsion: 300 gallons per acre.

D. Mechanical Seeding:

1. Uniformly apply seed to prepared seed bed to a depth of one half inch by a mechanical seeder such as a Brillon or approved equivalent.
2. Immediately following seeding, roll seed bed with a 200 pound roller and thoroughly water with a fine spray.
3. Immediately following rolling and watering, apply straw mulch uniformly to seed bed at the rate of three tons per acre.
4. Uniformly apply binder to all (mulch) slopes steeper than 4 horizontal on 1 vertical.

3.4 SODDING NEW LAWNS

- A. Lay sod within 24 hours of stripping. Do not lay sod if dormant or if ground is frozen.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to subgrade or sod during installation. Tamp and roll lightly to ensure contact with subgrade, eliminate air pockets, and form a smooth surface. Work fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
 1. Lay sod across angle of slopes exceeding 1:3.
 2. Anchor sod on slopes exceeding 1:6 with wood pegs spaces as recommended by sod manufacturer but not less than 2 anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within 2 hours of planting. During first week, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below the sod.

3.5 RECONDITIONING LAWNS

- A. Recondition existing lawn areas damaged by Contractor's operations, including storage of materials or equipment and movement of vehicles. Also recondition lawn areas where settlement or washouts occur or where minor regrading is required.
- B. Remove sod and vegetation from diseased or unsatisfactory lawn areas; do not bury into soil. Remove topsoil containing foreign materials resulting from Contractor's operations, including oil drippings, fuel spills, stone, gravel, and other construction materials, and replace with new topsoil.
- C. Where substantial lawn remains, mow, detach, core aerate, and rake. Remove weeds

before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

- D. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of it off the Owner's property.
- E. Till stripped, bare, and compacted areas thoroughly to a depth of 6 inches.
- F. Apply required soil amendments and initial fertilizers and mix thoroughly into top 4 inches of soil. Provide new planting soil as required to fill low spots and meet new finish grades.
- G. Apply seed and protect with straw mulch as required for new lawns.
- H. Apply sod as required for new lawns.
- I. Water newly planted areas and keep moist until new grass is established.

3.6 PROTECTION

- A. Immediately after seeding, protect seeded areas from all traffic until lawn is established.
- B. The Contractor shall be responsible for correction of all damage done by unauthorized traffic at no additional cost.

3.7 LAWN ESTABLISHMENT

- A. Watering:
 - 1. Keep seed bed moist until germination of seed by application of fine spray.
 - 2. Continue fine spraying after germination at four to seven day intervals as required to supplement natural rainfall so that all lawn areas received sufficient water for normal plant growth.
 - 3. Furnish all equipment necessary for artificial watering and be responsible for securing an adequate supply of water.
 - 4. The Contractor is completely responsible for all watering requirements until the lawn has been deemed satisfactory.
- B. Mowing:
 - 1. Mow lawn to a height of 2 inches when the overall height reaches 3 to 4 inches.
 - 2. Remove clippings when height of lawn is 6 inches or higher before mowing.
 - 3. Complete a minimum of three mowings in one growing season.
- C. Fertilize:
 - 1. After the second mowing, uniformly spread fertilizer at the rate of 5 pounds per thousand square feet.
 - 2. Thoroughly water lawn after applying fertilizer to facilitate penetration of fertilizer particles to the soil.
 - 3. The Contractor shall also be responsible for providing and applying fertilizer for the duration of one (1) complete growing season. Required application shall be as follows:

Construction Time

Fertilization Required

Spring	Starter fertilizer Spring turf builder with weed control Fall turf builder Winterizer application
Summer	Starter fertilizer Turf builder with Summerguard protection Fall turf builder Winterizer application Following Spring turf builder and weed control
Fall	Starter fertilizer Fall turf builder Winterizer application Following Spring turf builder and weed control

All fertilizers must be approved by the Landscape Architect prior to application.

D. Erosion Repair:

1. Repair all erosion damage by filling with topsoil, compacting, fertilizing, liming, seeding, and mulching according to original Contract requirements. This shall be required until such a time that the lawn has established itself and has been approved by the Landscape Architect.

E. Mulch Removal:

1. Remove and/or replace mulch that has been displaced.
2. Keep all paved surfaces and storm sewers free of mulch material.

F. Reseeding:

1. Reseed all areas which are sparse and/or spotty and where surface soils are highly visible not having a uniform stand of grass after the first mowing.
2. If a dense lawn is not established after three mowings in the first germination period, return in the following planting season to scarify, re-fertilize, topdress, re-seed, and re-mulch to establish a uniform stand of grass after three mowings in that following season. Dense lawn can be defined as areas where surface soils cannot be seen through the grass.

3.8 CLEANUP

- A. Remove trash and excess materials from project site.
- B. Maintain paved areas in a clean condition.
- C. Remove barriers and signs from project site at termination of establishment period.

3.9 PERFORMANCE

- A. Lawn will not be considered for payment and acceptance until a satisfactory stand of grass, as judged by the Landscape Architect, and is evident after three consecutive mowings and refertilization.

- B. The Landscape Architect will inspect the established lawn upon written request to the Owner by the Contractor.
- C. The Contractor shall provide to the School a Schedule of Procedure including, but not limited to, fertilizing, irrigation and aeration, for the care and maintenance of the lawns in the future, prior to acceptance of the work.
- D. Upon acceptance of the Work specified in this Section, the Contractor shall be relieved of further responsibility for care and maintenance of lawn.

END OF SECTION 329200

SECTION 329300

TREES, SHRUBS, GROUNDCOVERS, AND LANDSCAPING

PART 1 - GENERAL


1.1 WORK INCLUDED:

- A. This Section includes furnishing all labor, materials, equipment, plants, and incidental materials necessary to perform all operations related to the planting of all trees, shrubs, vines, herbaceous plants, ground covers, and for all appurtenant work, complete in place, maintained, and accepted, in accordance with the Contract Drawings and Specifications.
- B. The Contractor shall bear the responsibility and cost of furnishing and applying water or any other substances, as necessary to ensure the sustainability of plant materials, as part of the work of this contract.

1.2 RELATED WORK:

- A. Section 32 91 13, SOIL PREPARATION AND SOILS MIXES
- B.
- B. Section 32 92 19, SEEDING

1.3 SUBMITTALS:

In accordance with requirements of  Section 01 33 23 SUBMITTALS, the Contractor shall submit the following:

- A. Prior to planting, State nursery inspection certificates for all plant materials.
- B. Samples of the manufacturer's product data, as applicable, for the following materials:
 - 1. Limestone.
 - 2. Fertilizer.
 - 3. Sphagnum Peat Moss.
 - 4. Humus.
 - 5. Organic Compost.
 - 6. Manure.
 - 7. Mulch.
 - 8. Guying and Staking Apparatus.

9. Crepe Wrapping for tree trunks.
10. Anti-transpirant / Anti-desiccant.
11. Insecticides.
12. Herbicides.
13. Fungicides.

PART 2 - PRODUCTS

2.1 PLANT MATERIALS:

- A. The Contractor shall furnish and plant all plant materials as shown on the plans and in the quantities and sizes listed thereon. No substitutions shall be permitted without the written approval of the Engineer.
- B. Plants larger than those specified in the Plant List may be used if approved by the Engineer. However, use of such oversized plants shall not be considered grounds for any increase in the contract price. If the use of larger plants is approved, the required spread of roots or ball of earth shall be increased in proportion to the size of the plant and plant pits shall be increased as necessary.
- C. All plants shall be certified to have passed all required Federal and State inspection laws requiring ensuring freedom from plant diseases and insect infestations. The Contractor shall obtain clearance from applicable governing agencies, as required by law, before planting any plants delivered from outside the state in which they are to be planted.
- D. All plants shall be nursery-grown under climatic conditions and environmental stresses similar to those in the locality of the project. All plants shall originate from nurseries that are no more than one Hardiness Zone higher (as established by the Arnold Arboretum, Jamaica Plain, MA) than where the plant is to be installed. Plants also shall conform to the botanical names and standards of size, culture, and quality for the highest grades and standards as adopted by the American Association of Nurserymen, Inc. in the American Standard for Nursery Stock, ANSI-Z60.1, latest edition. All plants shall be legibly tagged with their proper botanical name.
- E. No heeled-in plants or plants from cold storage shall be used. All plants shall be typical of their species or variety and shall have a normal habit of growth. Plants shall be sound, healthy, and vigorous, well branched and densely foliated when in leaf; shall be free of disease, insects, eggs or larvae; and shall have healthy, well-developed root systems. All parts of the plant shall be moist and shall show active green cambium when cut.
- F. All nursery plants shall be balled and burlapped or container-grown and shall have been acclimatized for at least one growing season. Container-grown stock shall have been grown in a container long enough for the root system to have developed sufficiently to hold its soil together, firm and whole, after removal from the container. No plants shall be loose

in the container. Container-grown plants shall have no girdling roots and shall not be in a root-bound condition. Plants shall remain in their container until planted.

- G. Care shall be exercised in digging and preparing field-grown plants for shipment and planting. Balled and burlapped materials shall have solid unbroken balls of earth of sufficient size to encompass all fibrous feeding roots necessary to ensure successful recovery and development of the plants. Balls shall be firmly wrapped in untreated biodegradable burlap and tied securely with wire cages and/or jute twine. Roots or balls of plants shall be adequately protected at all times from sun and drying winds. No plant shall be accepted when the ball of earth surrounding its roots has been badly cracked or broken preparatory to or during planting, or after the burlap, staves, wire cage, rope, or platform in connection with its transplanting have been removed. Soil characteristics (i.e., composition, texture, pH, etc.) of all field-grown plants shall closely match those of the soil where plant materials are to be planted.
- H. The height of the trees, measured from the crown of the roots to the top of the top branch, shall not be less than the minimum size designated in the Plant List in the Drawings. The branching height for deciduous trees installed adjacent to or within walks shall be 7 feet minimum, having been pruned to this height at least 1 year prior to transplanting. Except when a clump is designated, the trunk of each tree shall be a single trunk growing from a single, unmutilated crown of roots. No part of the trunk shall be conspicuously crooked as compared with normal trees of the same variety. The trunk shall be free from sunscald, frost cracks, or wounds resulting from abrasions, fire, or other causes. All pruning cuts shall comply with acceptable horticultural practices. No pruning wounds having a diameter of more than 1½-inches shall be present. Any such wounds must show vigorous bark growth on all edges. Evergreen trees shall be branched to within 1 foot of the ground. No tree that has had its leader cut or die shall be accepted.
- I. Caliper measurements for tree trunks shall be taken 6-inches above ground for trees up to and including 4-inch caliper size and at 12-inches above ground for larger sizes.
- J. Shrubs shall meet the requirements for spread and/or height stated in the Plant List on the Drawings. The measures for height are to be taken from the crown or root flare to the average height of the top of the shrub mass (not the longest branch). The fullness of each shrub shall correspond to the trade classification "No. 1". Single stemmed or thin plants will not be accepted. The side branches must be generous, well-twiggged and the plant as a whole must be well-bushed to the ground. The plants must be in a moist, vigorous condition, free from dead wood, bruises or other root or branch injuries.
- K. Herbaceous plants, vines and groundcovers shall be of the size, age and/or condition designated in the Plant List on the Drawings.
- L. Plants shall be delivered only after preparations for planting have been completed. Plants shall be handled and packed in a horticulturally approved manner and all necessary precautions shall be taken to ensure that plants arrive on-site in a healthy vigorous condition. Trucks used for transporting plants shall be equipped with covers to protect plants from windburn, desiccation, and overheating during transport. Plants that have not been thoroughly watered shall not be accepted at the planting site. Any plants delivered to the site in a dry or wilted condition shall be rejected and replaced at no expense to the

Owner. All plant materials shall be protected, watered and otherwise maintained prior to, during, and upon delivery to the site.

- M. Plants shall be subject to inspection and approval by the Engineer at the place of growth, or upon delivery, for conformity to specification requirements as to quality, size, variety, and condition. Inspection and selection of plants before digging shall be at the option of the Engineer. The Contractor, or his representative, shall be present, if requested by the Engineer, for inspection of plants at the Nursery. Such approval shall not impair the right of inspection and rejection upon delivery at the site or during the progress of work, for size and condition of balls and roots, disease, insects and latent defects or injuries. Rejected plants shall be removed immediately from the site. Certificates of inspection of plant materials shall be furnished as may be required by Federal, State and other authorities to accompany shipments.

2.2 SOIL PREPARATION AND SOIL MIXES:

Soil Preparation and Soil Mixes shall be as specified in Section 31 91 13, SOIL PREPARATION AND SOIL MIXES.

2.3 SOIL ADDITIVES AND AMENDMENTS:

A. LIMESTONE:

Lime shall be an approved agricultural limestone containing at least 50 percent total oxides (calcium oxide and magnesium oxide). The material will be ground such that 50 percent of the material will pass through a No. 100 mesh sieve and 98 percent will pass a No. 2 mesh sieve. Lime shall be uniform in composition, dry and free-flowing and shall be delivered to the site in the original sealed containers, each bearing the manufacturer's guaranteed analysis.

B. FERTILIZER:

1. Fertilizer shall be a complete, standard commercial fertilizer, homogeneous and uniform in composition, dry and free-flowing, and shall be delivered to the site in the manufacturer's original sealed containers, each bearing the manufacturer's guaranteed analysis and marketed in compliance with State and Federal Laws. All fertilizer shall be used in accordance with the manufacturer's recommendations.
2. Fertilizer for tree, shrub and groundcover plantings shall contain all major plant nutrients and minor trace elements essential to sustain plant growth and shall have the following analysis:

Nitrogen (N)	Phosphorous (P)	Potassium (K)
10%	10%	10%

3. As approved by the Engineer, a slow release root contact fertilizer installed at the time of planting, may be used in place of the above, at the discretion of the Contractor.

- C. Organic Compost shall be a standard commercial product comprised of fully decomposed, 100 percent plant-derived, natural organic matter. Its composition shall furnish ample water holding capacity and cation exchange capacity for the retention of plant nutrients. Compost shall be free of sticks, stones, weed seeds, roots, mineral or other foreign matter and delivered air dry. It shall be free from excessive soluble salts, heavy metals, phytotoxic compounds, and/or substances harmful to plant growth and viability. Organic compost shall have an acidity range of 4.5 to 7.0 pH.
- D. Sphagnum Peat Moss shall be a standard commercial product. Its composition shall furnish ample water holding capacity and cation exchange capacity for the retention of plant nutrients. Peat moss shall be free of sticks, stones, weeds or weed seeds, roots, mineral or other foreign matter. It shall be free from toxic substances and/or compounds harmful to plant growth and viability. It shall be delivered air dry in standard bales and shall have an acidity range of 3.5 to 5.5 pH.
- E. Humus shall be natural humus, reed peat, or sedge peat. Its composition shall furnish ample water holding capacity and cation exchange capacity for the retention of plant nutrients. Humus shall be free of sticks, stones, weeds, roots, mineral or other foreign matter and/or toxic substances harmful to plant growth and viability. It shall be low in wood content, free from hard lumps and excessive amounts of zinc and delivered air dry in a shredded or granular form. The acidity range for humus shall be 5.5 to 7.5 pH, and the organic matter content shall be not less than 85 percent, as determined by loss on ignition. The minimum water holding capacity shall be 200 percent by weight on an oven-dry basis.
- F. Manure shall be well-rotted, leached, cow manure not less than 8 months or more than 2 years old. It shall be free of sawdust, shavings, or refuse of any kind and shall not contain more than 25 percent straw. It shall contain no substances harmful to plant growth. The Contractor shall furnish information regarding chemical disinfectants, if any, that may have been used in storage of the manure.

2.4 PLANTING MIXTURE:

Planting mix shall consist of 7 parts loam borrow and 1 part organic compost, humus, sphagnum peat moss, or manure, thoroughly blended.

2.5 WATER:

Water shall be furnished by the Contractor, unless otherwise specified, and shall be suitable for irrigation and free from ingredients harmful to plant growth and viability. The delivery and distribution equipment required for the application of water shall be furnished by the Contractor, at no additional cost to the Owner.

2.6 MULCH:

Mulch shall be fibrous pliable shredded softbark mulch, not exceeding ½-inch in width. It shall be 98 percent organic matter with a pH range between 3.5 and 4.5 and a moisture content not to exceed 35 percent. It shall be free of weeds, weed seeds, debris, and other materials harmful to plant growth and viability. Organic mulch shall be aged no longer than 2 years.

2.7 MATERIALS FOR STAKING, GUYING, AND WRAPPING:

- A. Tree stakes shall be sound, untreated 2 x 3 (nominal) x 8-foot length Douglas Fir reasonably free of knots. No paint or stain shall be used in conjunction with tree stakes. Tying material shall be flexible braided nylon webbing, ¾-inch wide and have a tensile strength of 900 pounds. Webbing shall be 'ArborTie', or approved equal.
- B. Drive anchors and guy wire assemblies shall be suitable for protecting trees and shall be sized in accordance with the manufacturer's recommendations. No materials shall be used for guying that will girdle, chafe, or otherwise injure trees.
- C. Tree wrap shall be duplex, waterproof kraft paper crinkled to 33-1/3 percent stretch, 4 to 6-inch wide strips. Tying materials shall be jute twine, 2-ply for shrubs and trees less than 3-inch caliper; 3-ply for larger plants.

2.8 TREE PAINT:

Tree paint shall not be used.

2.9 ANTI-TRANSPIRANT/ANTI-DESICCANT:

Anti-transpirant or anti-desiccant shall be 'Wilt-Pruf', as manufactured by Nursery Specialty Products, Inc., Groton Falls, NY, or approved equal. It shall be delivered in original sealed manufacturer's containers and used in accordance with the manufacturer's instructions.

2.10 INSECTICIDES:

- A. No insecticides shall be used on-site without the Contractor notifying and obtaining the prior approval of the Engineer.
- B. Insecticides shall be EPA registered and approved for use in public open spaces. All insecticides shall be handled by State licensed applicators only, delivered in the original sealed manufacturer's containers, and used in accordance with the manufacturer's instructions.
- C. Insecticide use shall be limited and selective, only to control specific insect infestations, as identified by the Contractor or the Owner's Representative that may result in the disfigurement, decline, or death of plant materials.

2.11 HERBICIDES:

- A. No herbicides shall be used on-site without the Contractor notifying and obtaining prior approval of the Engineer.
- B. Herbicides shall be EPA registered and approved for use in public open spaces. All herbicide shall be handled by State licensed applicators only, delivered in the original sealed manufacturer's containers, and used in accordance with the manufacturer's instructions.

- C. Herbicide for post-emergent application shall be glyphosate contact, 'Roundup', as manufactured by Monsanto, Inc., or approved equal.
- D. Herbicide use shall be limited and selective, only to control specific weed infestations that have been identified by the Contractor or the Owner's Representative.

2.12 FUNGICIDES:

- A. No fungicides shall be used on-site without the Contractor notifying and obtaining prior approval of the Engineer.
- B. Fungicides shall be EPA registered and approved for use in public open spaces. All fungicides shall be handled by State licensed applicators only, delivered in the original sealed manufacturer's containers, and used in accordance with the manufacturer's instructions.
- C. Fungicide use shall be limited and selective, only to control specific fungal pathogenic disease infestations, as identified by the Contractor or the Owner's Representative, that may result in the disfigurement, decline, or death of plant materials.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. All plants shall be subject to inspection and approval by the Engineer upon delivery to the site. No materials shall be planted until approval is received.
- B. All work shall be performed by skilled workers with a minimum of 2 years planting experience, in accordance with accepted horticultural/nursery practices, under the full-time supervision of a Certified Nurseryman or Arborist.
- C. All balled and burlapped plants that cannot be planted immediately upon delivery shall be set on the ground and the root balls shall be well protected with soil, wet moss, or other acceptable material. All foliage shall be protected and covered with perforated shade materials.
- D. The planting season for evergreen trees and shrubs shall extend from the time the soil becomes workable in the spring until new growth appears, and from September 15 until November 30 in the fall. Deciduous trees and shrubs shall be planted only when dormant, either prior to bud break and/or before leaves appear in the spring, or subsequent to their leaf drop in the fall. Ground covers shall be planted only after the last frost in the spring through mid-May. Planting season periods may be extended if weather and soil conditions permit only with the written approval of the Engineer. Extended or out-of-season planting requirements shall include application of antitranspirant and extra water as needed. Plant guarantee periods shall remain as stated below. Planting shall not be permitted in frozen ground.
- E. All plant locations and outlines for planting beds shall be staked out for review and potential adjustment by the Engineer before any excavation is begun. In the event that rock, underground construction work or obstructions are encountered in any proposed

planting pit or bed, the Engineer may select alternate locations. Where locations cannot be changed, the obstruction shall be removed, subject to the Engineer's approval, to a depth of not less than 3 feet below grade and not less than 6-inches below the bottom of the root ball when plant is properly set at the required grade. Removal of boulders or obstructions greater than 1 cubic yard in size shall be subject to approval and will be paid for by the Owner. No ledge will be removed to create planting pits or beds

- F. All planting pits shall be excavated with sloped walls, wider at the top than at the bottom, and scarified to eliminate glazing. Tree pits shall be at least 2 feet greater in diameter than the root ball of earth or root system. Shrub pits shall be at least 1 foot greater than the diameter of the root ball. Planting pits shall not be deeper than the height of the root ball.
- G. When excavation occurs in areas of heavily compacted earth, stones, concrete chunks or other foreign matter, pits shall be dug at least 3 times the width of the rootball. Excavated material from plant pits shall be disposed of as required.
- H. Container plants shall be removed from their growing container before planting. If roots are densely matted, the outer root mass shall be scored, sliced vertically, with a sharp knife to separate roots. All herbaceous plants and groundcovers shall be evenly spaced to produce a uniform effect and staggered in rows at intervals designated on the contract drawings.
- I. Shrubs and trees shall be set in the center of planting pits, plumb and straight, and at such a level that after settlement the crown of the roots will be 1-inch above the surrounding finished grade. Root ball masses shall not be loosened, broken or damaged. When balled and burlapped plants are set, planting mixture shall be compacted around bases of balls to fill all voids. All tying materials, twine and rope shall be cut and removed. Biodegradable burlap shall be laid back or cut away from the top half of the ball. If a wire basket is present, the upper 2/3 of the basket shall be cut away and removed. Do not remove the entire basket. Roots or bare root plants shall be properly spread out and planting mixture carefully worked in among them. Broken or frayed roots shall be cleanly cut.
- J. Backfill plant pits with planting mixture in layers of not more than 9-inches and firmly tamp each layer and water to sufficiently settle the backfilled soil before the next layer is put in place. When the planting pit is 2/3 backfilled, the hole shall be flooded and watered thoroughly so that the water level reaches the top of the planting pit. Allow water to soak in, then complete the backfilling operation. Immediately after planting pit is backfilled, a shallow basin 3-inches deep and slightly larger than the pit shall be formed with a ridge of soil for water retention. Form a common basin for plant materials throughout mass planting beds. After planting, lightly till the soil in planting beds between planting pits and rake smooth to eliminate compaction of soils.
- K. All planting hole basins shall be flooded with water twice within the first 24 hours of planting, and watered not less than twice per week until final acceptance of the work.
- L. All thin barked deciduous trees shall be wrapped after they are planted and before they are staked. Prior to wrapping, inspect trees for injury to trunks or improper pruning. Take corrective measures as necessary. Wrap trunks of all trees spirally from bottom to top with

tree wrap and secure top and bottom at 2-foot intervals with jute twine. The wrapping shall overlap and entirely cover the trunk from the ground to the height of the second branches and shall be neat and snug. Overlap shall be approximately 2-inches.

- M. Stake trees immediately after planting as detailed. All staking apparatus shall be adequate to hold the tree in a vertical position under severe weather conditions. All staking apparatus and tree trunk wrapping shall be removed and disposed of off-site by the Contractor at the end of one growing season.
- N. Immediately after planting and staking operations are complete, all plant pit basins and plant beds shall be covered with approved mulch to the depths designated on the plans. Mulch shall not contact tree bark, cover tree root flares, or shrub crowns. No mulch shall be applied prior to the first watering.
- O. The pruning of trees and shrubs shall only be permitted to remove dead or dying branch limbs and tips, sucker growth, water sprouts, crossing or rubbing branches, broken or damaged branches, diseased or insect infested limbs, and to preserve the natural character of the plant. Plant materials shall be pruned in accordance with American Nurserymen Association Standards and as required by the Engineer. Questionable weak limbs and branch removals that may disfigure the plant shall be left to the discretion of the Engineer. The tree leader shall never be permitted to be cut. Pruning shall be done with clean, sharp tools. All large pruning cuts that are ½-inch in diameter or larger shall be made along the bark branch ridge. Pruning cuts shall not breach or otherwise interfere with the branch collar. All pruning cuts less than ¼-inch diameter shall be made with hand pruners as close to the main stem as possible without damaging the cambium or bud. Tree paint shall not be used to cover pruning cuts.
- P. As the work proceeds, the Contractor shall remove all debris from the site, including but not limited to branches, rock, paper, and rubbish. All areas shall be kept clean, neat and in an orderly condition at all times. Prior to final acceptance, the Contractor shall cleanup the entire area to the satisfaction of the Engineer.

3.2 MAINTENANCE:

- A. Maintenance shall begin immediately after each plant is planted and shall continue until completion of the guarantee period and final acceptance of the project. Plants shall be watered, pruned, sprayed, fertilized, cultivated and otherwise maintained and protected. Tree guys and stakes shall be tightened and repaired. Defective work shall be corrected as soon as possible after it becomes apparent and weather and season permit.
- B. Settled plants shall be reset to proper grade and position, planting pits and common basins restored, and dead materials removed and replaced. Planting beds and individual basins shall be neat in appearance, maintained to their original layout lines and kept free of weeds. Mulch shall be replaced as required to maintain proper depths.
- C. Contractor shall make arrangements to provide sufficient water to maintain all trees, shrubs and plant materials until final acceptance. Plants shall be sprayed with anti-transpirant or anti-desiccant if required by seasonal conditions or as required by the Engineer.

- D. Planting areas shall be protected against trespass and damage of any kind during the maintenance period. This shall include the furnishing and installation of approved temporary fencing if necessary. If any plants become damaged during the maintenance period, they shall be treated or replaced as required by the Engineer at no additional cost to the Owner.

3.3 INSPECTION AND PRELIMINARY ACCEPTANCE:

- A. Contractor shall provide written notice to the Engineer not less than 10 days before the anticipated date of inspection for preliminary acceptance. The Engineer shall recommend preliminary acceptance of the work of this Section only after completion and re-inspection of all necessary repairs, renewals or replacements.
- B. Inspection and acceptance of plantings may be requested and granted in part, provided the areas for which acceptance is requested are relatively substantial in size, and with clearly definable boundaries. Acceptance and use of these areas by the Owner shall not waive any other provisions of this Contract.

3.4 GUARANTEE:

- A. All plant materials shall be guaranteed for a period of one year after the date of completion of the specified maintenance period and preliminary acceptance of the project by the Owner.
- B. When the work is accepted in part, the guarantee period shall extend from each partial acceptance to the terminal date of the last guarantee period. All guarantee periods terminate at one time.
- C. Plants shall be healthy, free of pests and disease. Plants shall exhibit vigorous growth, shall bear foliage of normal density, size and color and shall have no less than seventy-five percent (75%) of their branches alive at the end of the guarantee period. If the leader of any single-leader species is dead, the entire plant shall be considered dead.
- D. Any plant required under this Contract that is dead or unsatisfactory, as determined by the Engineer, shall be removed from the site. These shall be replaced as soon as weather permits during the specified planting season, at no additional cost to the Owner, until the plants live through one year.
- E. All replacements shall be plants of the same kind and size as specified on the Plant List. They shall be furnished and planted as specified above.
- F. The guarantee of all replacement plants shall extend for an additional one-year period from the date of their acceptance as replacement.
- G. Guarantee shall not apply to the replacement of unacceptable plants resulting from the removal, loss, or damage due to occupancy of the project in any part; vandalism or acts of neglect on the part of others; physical damage by animals, vehicles, etc.; and Acts of God, including but not limited to, catastrophic fire, hurricanes, riots, war, etc.

- H. In the instance of curtailment of water by local water authorities (when supply was to be furnished by the Owner), the Contractor shall furnish all necessary water by water tanker, the cost of which will be approved and paid for by the Owner.

3.5 FINAL INSPECTION AND FINAL ACCEPTANCE:

- A. At the end of the guarantee period, the Contractor shall provide written notice to the Engineer not less than 10 days before the anticipated date of final inspection for final acceptance.
- B. The Engineer shall recommend final acceptance of the work of this Section only after completion and re-inspection of all necessary repairs, renewals or replacements.

END OF SECTION 329300

Document1

SECTION 333100

SANITARY SEWAGE DISPOSAL SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This section includes the following:
 - 1. Construction of complete sanitary sewage collection and conveyance system.
- B. Related Sections include the following:
 - 1. Section 02 30 00: Soil Testing Services.
 - 2. Section 31 23 00: Earthwork.
 - 3. Section 31 23 16: Trenching, Backfilling and Compaction.

1.3 SUBMITTALS

- A. Contractor shall submit for review manufacturer's literature on all structures, piping, and equipment for the complete system. An additional 2 copies of the following shop drawings shall be submitted for regulatory submission requirements:

1.4 REGULATORY COMPLIANCE

- A. The contractor shall coordinate all inspections with the Engineer, the Architect, City of Albany, and the Albany County Health Department.

1.5 FUNCTIONAL DESCRIPTION

- A. Underground sanitary sewage systems shall be designed for H-20 loading conditions, complete with piping and covers. Pump Stations to include all controls and wiring.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Exercise care to prevent damage to materials during loading, unloading and transporting. Unload and store materials and equipment in strict accordance with the manufacturer's instructions.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE MANHOLES

- A. Precast, reinforced concrete manholes, as manufactured by Fort Miller Company, Inc. or an approved equivalent. Design load shall be according to AASHTO H-20. Reinforced concrete shall be 4,000 psi concrete. Air-entrained cement shall be used. Reinforcing steel shall conform to ASTM A615-A497, latest revision. Knockout units are not acceptable, unless stipulated. Units shall be provided with flexible watertight connections.
- B. Frame and Cover: Shall be EJ Group, Inc., Pattern 1207/1203, or an approved equivalent.
- C. Concrete: Shall be first class concrete, 4,000 psi.
- D. Manhole Steps: Manhole steps shall be made of steel and coated with co-polymer polypropylene plastic, Type PS2-OF, as manufactured by M. A. Industries, Inc. or an approved equivalent. The co-polymer polypropylene used in manhole steps shall conform to A.S.T.M.D. 4101-82 PP200B33454Z02.

The steel shall be ½" reinforcing rod grade 60 and conform to all requirements of ASTM A-615. The manhole steps shall be installed at the time of the manufacture of the manhole in accordance with the manhole step manufacturer's recommendations.
- E. Gaskets: Gaskets shall be E-Z Stik butyl gaskets, as manufactured by Concrete Products Supply Company, or an approved equivalent.

2.2 PRECAST CONCRETE GREASETRAPS

- A. Precast, reinforced concrete manholes, as manufactured by Fort Miller Company, Inc. or an approved equivalent. Design load shall be according to AASHTO H-20. Reinforced concrete shall be 4,000 psi concrete. Air-entrained cement shall be used. Reinforcing steel shall conform to ASTM A615-A497, latest revision. Knockout units are not acceptable, unless stipulated. Units shall be provided with flexible watertight connections.
- B. Frame and Cover: Shall be EJ Group, Inc., Pattern 1207/1203, or an approved equivalent.
- C. Concrete: Shall be first class concrete, 4,000 psi.
- D. The greasetraps must be vented in accordance with requirements of the manufacturer and the City (typically back through the inlet plumbing and to a roof vent). Proper venting prevents buildup of gases in the grease interceptor. Venting of hydrogen sulfide gas will minimize formation of sulfuric acid and resulting disintegration of concrete and corrosion of metal parts, e.g., re-bar.
- E. All external grease traps shall be either:
 - (a) watertight through manufacturers specification and warranty; or
 - (b) made watertight by the manufacturer, equipment supplier or installer using asphalt or synthetic polymer sealer specified by the grease trap manufacturer.

- F. All system components shall be constructed of corrosive-resistant materials.
- G. Where any portion of any component is to be placed at or below the ground water table, all system tankage, including the grease trap, shall be installed with appropriate counter weights, anchors or ballast.
- H. External grease traps shall be installed on a level stable base that has been mechanically compacted and onto which 6 inches of crushed stone has been placed to maximize uneven settling.
- I. External grease traps shall be provided with a minimum of 20-inch diameter manhole frame and cover to grade over the inlet and outlet tees.
- J. All external grease traps shall be accessible for inspection and maintenance. No structures shall be constructed directly upon or above the grease trap access locations.
- K. Backfill around the external grease trap shall be placed in such a manner as to prevent damage to the tank.

2.3 PVC GRAVITY SANITARY SEWER PIPE

- A. Pipe and fittings shall be polyvinyl chloride, conforming to ASTM D-3034 (latest revision) for SDR 26, Type PSM with rubber gasket joints. Pipe sizes, slopes, perforation patterns (where called for) shall be as called out on the plans.

2.4 PVC SEWER FITTINGS

- A. All fittings shall be of the same material as the pipe and shall be consistent therewith in strength, dimensions and utility.

2.5 DUCTILE IRON PIPE:

- A. Ductile iron pipe shall be centrifugally cast in metal or sandlined molds in accordance with ANSI/AWWA C151/A21.5 (latest revision), in 18 or 20 foot nominal lengths. The joint shall be of the push-on type which employs a single, elongated, grooved rubber gasket to effect the joint seal and/or the standard mechanical joint and accessories, ANSI Specification A21.11 with plain rubber gasket and/or the boltless flexible joint utilizing a machined ball end, rubber gasket, separately cast bell and high strength corrosion resistant, alloyed steel retainer ring, having an allowable deflection of 15 degrees.
- B. Ductile iron pipe shall have a rated working water pressure of not less than 350 psi, shall be thickness Class 52.

2.6 CEMENT MORTAR LINING:

- A. Ductile iron pipe and fittings shall be cement lined (twice standard thickness) and shall be paint seal coated, in conformance with ANSI Specification A21.4-1980 (LATEST REVISION).

2.7 DUCTILE IRON FITTINGS:

- A. Ductile iron fittings shall be compact, mechanical joint fittings which conform to the applicable requirements of ANSI/AWWA C153/A21.53. Mechanical joint glands shall be ductile iron. Ductile iron fittings shall be Class 350 for all sizes. All ductile iron fittings shall be cement lined as specified.

2.8 COUPLINGS: For sizes up to 12" pipe, couplings shall be Ford Style FC1, or equivalent.

- A. Sleeves: Gray iron ASTM A48.
- B. End Rings: Ductile iron per ASTM A536.
- C. Bolts and Nuts: Low alloy steel per ASTM A242 AND AWWA C111, heavy hex nuts.
- D. For pipe sizes 12" to 24", couplings shall be Ford Style FLC, or equivalent.

PART 3 - EXECUTION

3.1 TRENCHING, BACKFILLING AND COMPACTION

- A. As specified and as shown on the contract drawings, except for absorption trench system.
- 3.2 Construct structures in accordance with the details shown on the drawings or as approved by the Engineer. Set manhole frames and covers to the required grade and on a full bed of mortar. Do not use more than 8 inches of bricks; adjust frame and cover to grade.
- 3.3 All joints shall be as above specified and shall be installed in complete accordance with the requirements of the manufacturer.
- 3.4 If any defective pipe or jointing assembly is discovered after being installed, it shall be removed, corrected and replaced.
- 3.5 All pipes and jointing assemblies shall be cleaned before they are laid, and shall be kept clean until they are inspected and accepted with the completed work. Open ends of pipe shall be kept properly plugged to prevent entrance of dirt, debris and water. Unless otherwise directed, pipe shall be laid uphill, without any break in the line from manhole to manhole. When not laying pipe, the end of the line shall be kept properly closed, so as to prevent entrance of all dirt and water.
- 3.6 Trenches in which various pipes are to be constructed shall be excavated in open cut from the surface, unless otherwise directed in writing, and in all cases in such manner and to such depths and widths (for sewer trenches not less in width than 12 inches greater than the maximum external diameter of the barrel of the pipe), as will give suitable room for building of the structure it is to contain and for removing from the trench or other excavation any material which the Engineer may deem not proper for foundation.
- 3.7 In all pipe trenches, suitable materials shall be filled in around the pipe, and to a height of not less than 1 foot, and to a greater height if so directed, over the top of the pipe. This fill shall be brought up evenly on both sides of the pipe in layers of a thickness directed by the

Engineer. Each layer shall be tamped and thoroughly consolidated to provide proper support and bearing for the pipe, and so as not to disturb the line and grade of the pipe. The backfill of the trench above this point over the top of the pipe shall be as specified hereafter.

- 3.8 Care must be taken not to move, without the consent of the Engineer, any sewers, drains, culverts, water, gas or other pipes or poles or other structures, and in crossing such pipes or structures, or in running parallel with or near them; they shall be securely hung, braced and supported in place until the work is completed. Whenever it is necessary to interfere with said structures, the contractor, at his own expense, shall maintain their respective services, and if necessary for that purpose, shall lay temporary water, gas or other pipes, or other structures. The Contractor shall repair all damage done to any of said structures through his acts or neglect, and shall keep them in repair until one year after the completion of the work. He shall leave them in as good condition as they were previous to the commencement of the work.
- 3.9 In case of a gas, water or other pipe becoming broken in the prosecution of the work, the Contractor shall give immediate notice to the proper authorities, and shall be responsible for any damage to persons or property caused by such breaks, and failure to give prompt notice to the authorities shall make the Contractor responsible for any needless loss of water or gas.
- 3.10 The trench and other excavations above pipe grade shall be carefully refilled as soon as possible after construction of the pipe line or other structure with such of the excavated materials, and in such order as may be from time to time directed. No portion of a trench or other excavation shall be backfilled until the structure contained in it has been examined and approved. When, for any reason the work is left unfinished, all trenches and other excavations shall be filled, if so required by the Engineer, and the roadways and sidewalks left unobstructed, with their surface in a safe and satisfactory condition. In unpaved areas, the backfill above the pipe shall be carefully consolidated, in order to prevent settlement. The trench shall be tamped sufficiently to prevent any settlement of or damage to adjacent structures.

In all pipe trenches, suitable materials shall be filled in around the pipe, and to a height of not less than 1 foot, and to a greater height if so directed, over the top of the pipe. This fill shall be brought up evenly on both sides of the pipe in layers of a thickness directed by the Engineer. Each layer shall be tamped and thoroughly consolidated to provide proper support and bearing for the pipe, and so as not to disturb the line and grade of the pipe. The backfill of the trench above this point over the top of the pipe shall be as specified hereafter.

- 3.11 No rock or frozen earth over 10 inches in diameter shall be put in the trench until the refilling has reached at least 2 feet above the top of the pipe lines, and then not unless specifically permitted. All spaces between suitable pieces of rock shall be thoroughly filled with earth by backfilling with alternate layers of rock and earth.
- 3.12 When the trench is in a macadamized or paved street, the backfilling shall be done in the following manner:

After the backfill has been placed around the pipe or such other structure, to a height of 1 feet over the top, the remaining backfill shall be deposited in 6 inch layers and thoroughly tamped. The tamping shall be done by suitable mechanical means so far as possible. The machine used shall be of a type satisfactory to the Engineer and shall be used in such a

manner as will thoroughly compact the backfill to a degree which will ensure against later settlement in the judgment of the Engineer. In all cases, special care shall be taken to see that the spaces at the sides of the trench or other excavations are thoroughly filled and rammed. If necessary, the earth shall be moistened during the operation.

- 3.13 The Contractor shall furnish, put in place and maintain such sheeting and bracing as may be required to support thoroughly the sides of the excavation (whether above or below pipe grade), and to prevent any movement which might injure the sewers, diminish the width necessary for proper drainage, or otherwise injure or delay the work or interfere seriously with adjoining structures or operations. That portion of the sheeting in the trench extending below the top of the pipes shall be withdrawn, unless otherwise directed by the Engineer, before more than 6 inches of earth is placed above the top of the pipes. As the trench is refilled, the sheeting and timbering shall be removed in such a manner as to avoid the cave-in of the trench. The vacancy left by the sheeting shall be carefully refilled by ramming, or otherwise as directed. Where cavities or pockets have developed outside of sheeting, they shall be carefully backfilled and consolidated to the satisfaction of the Engineer, even if it is necessary to make an opening from the ground surface for this purpose.
- 3.14 Cut ends of pipe shall be reamed/scraped clean of all loose material as a result of cutting the pipe.
- 3.15 Thoroughly flush all sanitary sewers, manholes, and force mains prior to testing.
- 3.16 TESTING (GRAVITY SEWERS)
- A. Inspection:
1. After backfilling full depth, gravity sewer pipes shall have been so constructed that a visual inspection from manhole to manhole through the pipe shows a clear full circle with no bends, dips, rises or obstructions.
- B. Correction:
1. Correct all alignment errors.
 2. Reinspect to verify that alignment errors have been corrected.
- C. Low Pressure Air Test (for gravity sewers): Test all sewer pipe in conformance with ASTM C-828, after thoroughly flushing sewers, and as follows:
1. Test pressures specified shall be commensurately increased for groundwater elevations above the pipe, in accordance with UNI B-6 by Uni-Bell Plastic Pipe Association.
 2. Clean and wet the inside of the pipe thoroughly before testing.
 3. Insert test plugs in ends of pipe to be tested.
 4. Slowly fill the pipe with air to a pressure of 4 PSIG and maintain pressure between 4 and 3.5 PSIG for at least two minutes for temperature stabilization.
 5. Check all plugs for tightness.
 6. With a pressure of 4 PSIG \pm in the pipe, disconnect the air supply.
 7. Allow pressure to drop to 3.5 PSIG, then determine the elapsed time for the pressure to further drop to 2.5 PSIG.
 8. The line is considered acceptable if the time for the pressure to drop from

3.5 PSIG to 2.5 PSIG is not less than the amount determined by the following table:

<u>MINIMUM ACCEPTANCE TIMES</u>			
<u>Diameter (In.)</u>	<u>Min. Time (Min.:Sec)</u>	<u>Length For Min. Time (Ft.)</u>	<u>Time For Longer Length (Sec.)</u>
4	3:46	597	0.380L
6	5:40	398	0.854L
8	7:34	298	1.520L
10	9:26	239	2.374L
12	11:20	194	3.418L
15	14:10	159	5.342L
18	17:00	133	7.692L
21	19:50	114	10.470L
24	22:40	99	13.674L
27	25:30	88	17.306L
30	28:20	80	21.366L

Where L is the length of sewer when it is above the "Length for Min. Time"

9. If the leakage exceeds the specified amount of the section under test, the contractor shall make the necessary repairs and retest until acceptable leakage requirements are met.

3.17 Thoroughly flush all sanitary sewers and manholes.

3.18 CORRECTION

- A. Correct all leaks and alignment errors.
- B. Retest and inspect until satisfactory results are achieved.

3.19 LEAKAGE TESTING FOR SANITARY MANHOLES

- A. Perform leakage test as described in Paragraph 3.18 above, with the following allowable leakage:
 1. Allowable loss for each 4 ft. diameter manhole is 0.057 gallons per hour for every foot of water above the invert of the sewer.
 2. Allowable loss for each 5 ft. diameter manhole is 0.071 gallons per hour for every foot of water above the invert of the sewer.

END OF SECTION 333100

SECTION 334000

STORM SEWER SYSTEMS

PART 1 – GENERAL

- 1.1 Applicable provisions of the Contract, General Clauses and General Specifications govern work under this section.
- 1.2 **WORK INCLUDED:** Construction of new catch basins, drywells, inline drains, drain basins, storm sewer piping, and appurtenances. Provide temporary means of conveyance for all existing disrupted systems until new systems are operational.
- 1.3 The Contractor shall submit drawings for the Engineer's review of each precast catch basin, drywell, and pipe which he proposes to furnish.
- 1.4 **RELATED SECTIONS**
 - Section 31 23 00: Earthwork.
 - Section 31 23 16: Trenching, Backfilling and Compaction.
 - Section 32 10 00: Roadway and Miscellaneous Surface Subbase.

PART 2 - PRODUCTS

- 2.1 **CATCH BASINS:** Shall be precast concrete having a 28-day compressive strength of 4,000 psi, minimum 5% air entrainment, and reinforcing steel meeting ASTM A615-A497. They shall be designed for AASHTO H-20 loading, as manufactured by Fort Miller Company, or an approved equivalent. Pipe connections shall be accomplished with masonry cement (knockouts are not acceptable). (Sizes as indicated on Plans.)
- 2.2 **PLASTIC CATCH BASINS/DRAINAGE BASINS:** Inline drain/drain basin designed for AASHTO H20 loading, with cast iron grate, as manufactured by Nyloplast America, Inc. or equivalent. Grates shall be lockable. Basin sizes per Plans.
- 2.3 **STEPS:** Where depth of catch basin is greater than 2 feet, MA Industries PS-2-PF Polypropylene or Alcoa #16027B or equivalent aluminum steps shall be provided 12 inches on center.
- 2.4 **CATCH BASIN INSIDE DIMENSIONS:** As shown on Plans.
- 2.5 **CONCRETE BRICK:** Shall meet New York State Department of Transportation Specification 704.02, Concrete Brick.
- 2.6 **MORTAR:** Shall meet New York State Department of Transportation Specification 705.21, Mortar for Concrete Masonry.
- 2.7 **BACKFILL MATERIALS:** See Section 31 23 16 - Trenching, Backfilling and Compaction, and the Contract Drawings.
- 2.8 **GRADE ADJUSTMENT:** Solid concrete brick or concrete grade rings.

2.9 FRAME AND GRATES: As shown on plans.

2.10 SMOOTH INTERIOR CORRUGATED POLYETHYLENE STORM SEWER PIPE: This specification applies to high density polyethylene (HDPE) corrugated pipe with an integrally formed smooth interior. Pipe products must be NYSDOT approved and be included on their list of approved manufacturers. Eight and 10-inch diameter pipes shall conform to the strength requirements of AASHTO M252 with the addition that the pipe have a smooth interior liner. Twelve to thirty-six-inch diameter pipe shall conform to AASHTO M294 Type S. Pipe shall be perforated in specific locations where indicated on the plans.

Pipe shall be Type HI-Q as manufactured by Hancor, Inc., Type N-12 as manufactured by Advanced Drainage Systems, Inc., or approved equivalent.

The pipe and fittings shall be free of foreign inclusions and visible defects. The ends of the pipe shall be cut squarely and cleanly so as not to adversely affect joining.

The nominal size for the pipe and fittings is based on the nominal inside diameter of the pipe. Corrugated fittings may be either molded or fabricated by the manufacturer.

Fittings produced by manufacturers other than the supplier of the pipe shall not be permitted without the approval of the Engineer.

Joints shall be made with manufacturer's integral-bell system, split couplings or sleeve type couplers, corrugated to match the pipe corrugations, and shall engage a minimum of 6 corrugations for 12" and 24" diameter and 4 corrugations for 30" and 36" diameter pipe. The coupler shall be fabricated by the pipe manufacturer to ensure compatibility.

2.11 FLARED END SECTION: Prefabricated, galvanized steel end sections complying with NYSDOT Specification 707-10, as manufactured by Lane Enterprises, Inc.

PART 3 - EXECUTION

3.1 Precast catch basin and inline drains shall be located as indicated on contract plans and as specified. Proposed locations shall be excavated to a depth as indicated on plans. Catch basins shall then be placed on a subbase per the plans and Section 31 23 16.

3.2 A minimum of one course of concrete brick or concrete grade ring shall be placed and mortared between the frame and top of catch basin.

3.3 The frame and grate shall be properly positioned and mortared to the top of the concrete bricks/grade rings as required.

3.4 Adjust existing catch basins to the new grade as required. Replace top sections if required or install extension sections of precast concrete compatible with the existing structure.

3.5 All joints shall be as above specified and shall be installed in complete accordance with the requirements of the manufacturer. Joints shall be watertight.

3.6 If any defective or damaged pipe or jointing assembly is discovered after being installed, it shall be removed, corrected and replaced. All expense resulting from defective or

damaged pipe or jointing assemblies shall be borne by the Contractor.

- 3.7 All pipes and jointing assemblies shall be cleaned before they are laid, and shall be kept clean until they are inspected and accepted with the completed work. Open ends of pipe shall be kept properly plugged to prevent entrance of dirt, debris and water. Unless otherwise directed, pipe shall be laid uphill, without any break in the line from manhole to manhole. When not laying pipe, the end of the line shall be kept properly closed, so as to prevent entrance of all dirt and water.
- 3.8 Pipe bedding will be required for all storm sewer lines, where excavation of rock is encountered, where pieces of concrete or masonry or other debris is encountered, or where the subgrade is found to be unstable or to include ashes, cinders, refuse, organic material or other unsuitable material.
- 3.9 The Contractor will establish line and grade for the construction of all storm sewers by staking the location of each manhole and/or catch basin and/or drywell providing elevations (based upon contract datum) at each drainage structure. The Contractor shall work from such points and shall be responsible for all measurements necessary to establish such supplementary lines and grades that are required in order for him to install the storm sewers on the lines and at the grades shown on the drawings, or as modified at the request of the Engineer to meet changed conditions or as a result of modifications to the work covered by the contract.
The Contractor shall furnish, at his own expense, such stakes and other required equipment, tools and materials, and all labor that may be required in laying out the work as described above.
- 3.10 Trenches in which various pipes are to be constructed shall be excavated in open cut from the surface, unless otherwise directed in writing, and in all cases in such manner and to such depths and widths that will give suitable room for building of the structure it is to contain and for removing from the trench or other excavation any material which the Engineer may deem not proper for foundation. For storm sewer lines, the maximum width of trench at the top of the pipe shall comply with specified limitations and details shown on the plans.
- 3.11 In all pipe trenches, suitable backfill materials, as called out on the plans, shall be filled in around the pipe as shown on the plans. This fill shall be brought up evenly on both sides of the pipe in 8 inch maximum layers. Each layer shall be tamped and thoroughly consolidated to provide proper support and bearing for the pipe, and so as not to disturb the line and grade of the pipe. The backfill of the trench above this point over the top of the pipe shall be as specified hereafter and/or as shown on the plans.
- 3.12 The length of the trench to be opened or the area of the surface to be disturbed or unrestored at any one time shall be limited with regard to expeditious construction and to the convenience and comfort of the persons residing in the neighborhood or frequenting the project area in question.

New trenching will not be permitted when earlier trenches need backfilling or labor is needed to restore the surfaces of streets or sidewalks to a safe and proper condition.
- 3.13 First class bedding which will provide a load factor of 1.9 will be required for the installation of sewer pipe lines. This may be accomplished by either of the following methods:

- A. By so-called shaped bedding with tamped backfill. The bottom of the trench excavation shall be shaped to conform to a cylindrical surface with radius at least 2 inches greater than the radius of the outside diameter of the pipe and for a width sufficient to allow six-tenths of the width of the pipe barrel to be bedded in pipe bedding placed in the shaped excavation.

Carefully compacted backfill shall be placed at the sides of the pipe and to a depth above the top of the pipe as shown on the plans.

- B. Compacted bedding with tamped material placed on a flat trench bottom. Granular material shall be as called out on plans and in Section 31 23 16, with minimum bedding depth of 4 inches or one-fourth the outside pipe diameter, whichever is greater, and shall extend half way up the pipe barrel of the sides. The remainder of the side walls and a minimum depth over the top of the pipe as shown on the plans shall be backfilled with carefully compacted selected materials.

- 3.14 All excavated and other materials shall be so placed as not to endanger the work, and so that free access may be had at any time to all parts of the trench and to all structures and pipes in the vicinity, and shall be kept neatly piled, so as to inconvenience as little as possible public travel or the adjoining tenants. All fences and other structures in the vicinity of the work shall be protected and, if injured, shall be repaired or replaced. All trees in the vicinity of the work shall be protected in a satisfactory manner.

- 3.15 The Contractor shall provide and maintain at his expense ample means and equipment such as pumps, well point systems, drains, and sumps for dewatering and properly disposing of water entering the trenches and other parts of the work. The excavation shall be maintained in a dry condition and no foundation materials, pipe or concrete shall be placed in the water. Dewatering shall be done in an approved manner such that the subgrade can be trimmed, foundation materials, pipe or concrete placed in the dry, without disturbing bearing materials, and water from the excavation shall be disposed of in such manner that it will cause no injury to property or inconvenience to the public.

Whenever high water tables are encountered and where subgrade consists of soils such as fine silty sands, which are easily disturbed by flowing water, uplift pressures shall be relieved by well points extending as far below the base of the trench as necessary. For subgrades of non-plastic silt or silty fine sand, the groundwater shall be drawn down to a level at least two feet below the final invert grade of the pipe by well points or other approved means.

Care should be taken to shut down dewatering equipment slowly to avoid uplift and softening of the materials supporting the pipe and appurtenances.

- 3.16 Care must be taken not to move any sewers, drains, culverts, water, gas or other pipes or poles or other structures, and in crossing such pipes or structures, or in running parallel with or near them; they shall be securely hung, braced and supported in place until the work is completed. Whenever it is necessary to interfere with said structures, the Contractor, at his own expense, shall maintain their respective services, and if necessary for that purpose, shall lay temporary water, gas or other pipes, or other structures. The Contractor shall repair all damage done to any of said structures through his acts or neglect, and shall keep them in repair until one year after the completion of the work. He shall leave them in as good condition as they were previous to the commencement of the work.

- 3.17 In case of a gas, water or other pipe becoming broken in the prosecution of the work, the Contractor shall give immediate notice to the proper authorities, and shall be responsible for any damage to persons or property caused by such breaks, and failure to give prompt notice to the authorities shall make the Contractor responsible for any needless loss of water or gas.
- 3.18 The trench and other excavations above pipe grade shall be carefully refilled as soon as possible after construction of the pipe line or related structure. No portion of a trench or other excavation shall be backfilled until the structure contained in it has been examined and approved. When, for any reason the work is left unfinished, all trenches and other excavations shall be filled, and the roadways and sidewalks left unobstructed, with their surface in a safe and satisfactory condition. In unpaved areas, the backfill above the pipe shall be carefully consolidated, in order to prevent settlement. The trench shall be tamped sufficiently to prevent any settlement of or damage to adjacent structures.
- 3.19 No rock or frozen earth over 10 inches in diameter shall be put in the trench until the refilling has reached at least 2 feet above the top of the pipe lines, and then not unless specifically permitted. All spaces between suitable pieces of rock shall be thoroughly filled with earth by backfilling with alternate layers of rock and earth.
- 3.20 PIPE-TO-CATCH BASIN CONNECTION: Pipe connections to catch basin shall be mortared into the catch basin with masonry cement. Care shall be taken with a method satisfactory to the Engineer when making holes in existing catch basins to maintain the integrity of the catch basin. The end of all inlet and outlet pipes in concrete storm structures within NYSDOT right-of-ways shall be flush with the inside wall. Outside of NYSDOT right-of-way, inlet pipes may project inside basins as shown on plans. Discharge pipe ends shall be flush with inside wall. All connections shall be watertight. Knockouts are not acceptable.
- 3.21 Installation shall be in accordance with ASTM Recommended Practice D-2321. When within New York State right-of-way, installation shall conform to NYSDOT Specifications 206 and 18603.9801XX and the NYSDOT standard sheets.
- 3.22 Do not enter or disturb on-site wetlands while performing work under this section and contract, unless otherwise ordered.
- 3.23 FIELD QUALITY CONTROL
- A. Clear interior of piping and structures of dirt and 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 plug in end of incomplete piping at end of day and when work stops.
 3. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.
- B. The Contractor shall at all times provide the means necessary to prevent damage to structures, piping, etc., during all phases of construction. Any damage caused during construction shall be replaced, to the satisfaction of the Engineer, at no cost to the Owner.

END OF SECTION 334000

SECTION 334010

UNDERGROUND STORMWATER DETENTION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of the contract, including the General and Supplementary Conditions and Division 1 specification sections apply to this section.

1.2 WORK INCLUDED:

- A. Under this section the Contractor shall furnish and install underground stormwater detention civil works as specified and as shown on the plans.

1.3 RELATED SECTIONS

- Section 31 23 00: Earthwork
- Section 31 23 16: Trenching, Backfilling and Compaction
- Section 33 40 00: Storm Sewer Systems

1.4 FUNCTIONAL DESCRIPTION:

- A. Underground stormwater detention systems shall be designed for H-20 loading conditions. All pipe and fitting connections shall be gasketed and water tight (HDPE) and soil tight (metal pipe).

PART 2 – PRODUCTS

2.1 SUBSURFACE MODULAR SYSTEM:

- A. Modules shall be StormTank Module 20 Series as manufactured by StormTank or approved equivalent.
 - 1. Size, inverts & layout to be as shown on plans.
- B. High density polyethylene (HDPE) pipe with watertight joints, ADS N-12 WT IB pipe or approved equal. Pipe shall meet AASHTO M294, Type S or ASTM F2306.
- C. WT IB pipe shall be joined using a bell & spigot joint. The joint shall be watertight according to the requirements of ASTM D3212. Gaskets shall meet the requirements of ASTM F477. 12- through 60-inch (300 to 1500 mm) diameters shall have a bell reinforced with a polymer composite band. The bell tolerance device shall be installed by the manufacturer. Pipe & fitting connections shall be with a bell and spigot connection utilizing a spun-on or welded bell and valley or saddle gasket. The joint shall meet the watertight requirements of ASTM D3212, and gaskets shall meet the requirements of ASTM F477.

- D. Fittings shall conform to ASTM F 2306 and meet joint performance indicated above for fitting connections. Custom fittings are available and may require special installation criterion.

PART 3 – EXECUTION

3.1 GENERAL

1. Review installation procedures and coordinate the installation with other construction activities, such as grading, excavation, utilities, construction access, erosion control, etc.
2. Engineered drawings supersede all provided documentation, as the information furnished in this document is based on a typical installation.
3. Coordinate the installation with manufacturer's representative/distributor to be on-site to review installation instructions.
4. Components shall be unloaded, handled and stored in an area protected from traffic in a manner to prevent damage and UV degradation.
5. Assembled modules may be walked on, but vehicular traffic is prohibited until backfilled per Manufacturer's requirements.
6. Ensure all construction occurs in accordance with Federal, State and Local Laws, Ordinances, Regulations and Safety Requirements.
7. Extra care and caution should be taken when temperatures are at or below 40° F (4.4° C).
8. Check for any damaged material, report damage to Site Representative. All plastic wrap should be removed to prevent damage from heat or UV

3.2 EXCAVATION

1. Stake out and excavate, in accordance with OSHA regulations, to elevations per approved plans. Excavation Requirements:
2. Recommended Sub-grade excavation is a minimum of 6" (152 mm) below designed Module invert.
3. A 4" (102 mm) leveling bed may be acceptable, contact your Module Representative for further details.
4. The excavation should extend a minimum of 12" (305 mm) beyond the module unit's dimensions in each length and width to allow for adequate placement of side backfill material.
5. Remove objectionable material encountered within the excavation, including protruding material from the walls.

3.3 SUB-GRADE PREPARATION

1. Unstable, unsuitable and/or compromised areas should be brought to the Engineer's attention and mitigating efforts determined.
2. Sub-grade shall be unfrozen, free of lumps or debris and contain no standing water or mud.
3. Sub-grade must be prepared, per the Engineer of Record, to provide a minimum bearing capacity and prevent settlement.

- 4 Maximum applicable settlements cannot exceed long-term 1/2" (12.7 mm) differential settlement between any two adjacent units within the system.
- 5 Sub-grade must be designed to ensure soil bearing capacity is maintained throughout all soil saturation levels.

3.4 LEVELING BED INSTALLATION

- 1 A layer of geotextile fabric is required around the excavation to prevent material migration.
- 2 Geotextile fabric shall be placed per geotextile fabric manufacturer's recommendations and as shown on plans and details.
- 3 Place a Leveling Bed per engineer plans. Material should be free of voids, lumps, debris, sharp objects and compacted.

3.4 MODULE PLACEMENT

- 1 Install geotextile fabric as specified.
- 2 Geotextile fabric shall be placed per geotextile fabric manufacturer's recommendations.
- 3 Mark the footprint of the modules for placement.
- 4 Ensure module starting point is square prior to Module placement, this will ensure proper layout of units.
- 5 Care should be taken to note any connections, ports, debris rows or other irregular units to be placed.
- 6 Install the individual modules by hand, as directed by manufacturer.
- 7 The modules should be installed as shown in the Module submittal drawings with the short side of perimeter modules facing outward, except as otherwise required.
- 8 Make sure the top/bottom platens are in alignment in all directions.
- 9 Install the modules to completion, taking care to avoid damage to the geotextile and/or liner material.
- 10 Locate any ports or other penetration of the Modules.
- 11 For Observation Ports: a. Layout and cut opening into the top platen per standard Observation Port Detail. b. Place port into opening, c. If port is along the perimeter, cut the flange plate flush with the edge of the end Module.
- 12 For Connections: a. Locate and mark the connection opening in the side panels. b. Remove side panels and cut opening. c. Reinstall side panels. d. Install pipe (slip fit) Note: When performing lateral connections to the Module system, the platens and columns are not to be modified/cut as to not compromise the integrity of the system.
- 13 Upon completion of module installation, wrap the modules in geotextile fabric and/or liner.

3.5 SIDE BACKFILL

- 1 Inspect all geotextile, ensuring that no damage exists; which will allow sediment into the module system.
- 2 Once the geotextile is secured, begin to place the Side Backfill.
- 3 Backfill sides "evenly" around the perimeter without exceeding single 12" (305 mm) lifts.
- 4 Place material utilizing an excavator, dozer, or conveyor boom from the native soil surrounding the excavation, do not directly access the system during side backfilling.
- 5 Compact the backfill material to settle the stone and provide a uniform distribution.

3.6 TOP BACKFILL

- 1 Begin to place the top backfill.
- 2 Place material utilizing a low ground pressure (LGP) equipment, dozer (Maximum D5 LGP or similar) or preferably a conveyor boom.
- 3 DO NOT DRIVE OR DUMP FROM DUMP TRUCKS DIRECTLY ONTO THE MODULES.
- 4 DO NOT DRIVE ON THE MODULES WITHOUT A MINIMUM 12" (305 mm) COVER.
- 5 Compact as required by engineer of record.
- 6 Utilize a static roller producing less than 10 psi per roller, unless otherwise approved, while ensuring a minimum 12" (305 mm) of cover. To do so, a minimum 15" (381 mm) layer of material may be required to account for compaction.
- 7 Sheep foot rollers are not permitted.
- 8 Upon completion of top backfilling, if specified, wrap the system in geotextile fabric and/or liner per the material manufacturer's recommendations.
- 9 Install metallic tape around the perimeter of the system to mark the area for future utility detection.

END OF SECTION 334010

SECTION 334626

GEOTEXTILE FABRICS

PART 1 – GENERAL

1.1 RELATED WORK

Section 02 10 00: Tree Protection and Trimming.
Section 31 22 13: Rough Grading.
Section 31 23 00: Earthwork.
Section 31 25 00: Sediment and Erosion Control.

1.2 SUBMITTALS

- A. Product Data: Manufacturer's catalog sheets, specifications, and installation instructions for each item specified.
- B. Samples: 12 inch x 12 inch sample of prefabricated drainage panel.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Prefabricated Drainage Panel; Any of the Following:
 - 1. MIRADRAIN 6000 by Nicolon/Mirafi Group
 - 2. J-Drain 300 Composite Drainage System by JDR Enterprises, Inc.
 - 3. Hydraway 300 by Monsanto
 - 4. Or approved equivalent
- B. Geotextile Woven Polypropylene Reinforcement Fabric:
 - 1. Amoco 2006 by Amoco Fabrics and Fibers Co.
 - 2. Mirafi 500x by Nicolon/Mirafi Group
 - 3. Or approved equivalent
- C. Geotextile Filter Fabric:
 - 1. Amoco 4545 by Amoco Fabrics and Fibers Co.
 - 2. Or approved equivalent

PART 3 - EXECUTION

3.1 PROTECTION

- A. Protect prefabricated drainage panel from sunlight during transportation and storage.

3.2 INSTALLATION

- A. Install the Work of this Section in accordance with the manufacturer's printed instructions.

END OF SECTION 334626