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Project Manual (Technical Sections)

Athletic Field Construction
Ella T. Grasso Technical High School
189 Fort Hill Road
Groton, CT

DCS Project No.: BI-RT-877A
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PART 1 - GENERAL

1.1 RELATED DOCUMENT

A. Drawings and general provisions of Contract, including General Supplementary Conditions, and Division 1 Specification sections, apply to this section.

1.2 SUMMARY

A. Provide all labor, materials, necessary equipment and services to complete the work called for in this Section or as shown on the plans, including but not necessarily limited to the following:

1. All proposed construction signs and support posts required.
2. Barricades, traffic cones, warning lights and protective safety fence as required to establish roadway closing and to protect open trenches.
3. Protect pedestrian and vehicular traffic at all times on site. Provide flagmen as required.
4. Scheduling of activities and deliveries to minimize impact to traffic. Access to site for construction and deliveries should be coordinated with school officials to avoid beginning and ending of school time periods.
5. Installation of impact attenuation systems if required.

B. Related Work: The following sections contain requirements that may apply to this section:

1. Division 31, Section “Site Clearing”
2. Division 31, Section "Earth Moving".
3. Division 32, Section "Bituminous Concrete Asphalt Paving.”

PART 2 – PRODUCTS

2.1 MATERIALS

A. All materials, barricades, cones, etc. shall conform to the requirements described in the State of Connecticut Department of Transportation Form 817 and standard D.O.T. procedures.

PART 3 – EXECUTION

3.1 GENERAL

A. Protect from vehicular and pedestrian traffic during all operations. Construct all barricades, cones, and safety fence as shown on the drawings or as directed by the Owner's Representative.

B. All construction signs shall be constructed of aluminum with a minimum thickness of 0.100 mils. All colors shall be reflectorized and shall conform to State of Connecticut Department of Transportation Form 817, Section 12.20.

C. Sign supports - Wt./Ft. = 3 LB. and shall conform to Standard Connecticut sign mounting details.

D. Construction barricades shall conform to State of Connecticut Department of Transportation Form 817, Section 9.79. Traffic cones and drums shall conform to Sections 9.77 and 9.78 of Form 817.

E. The locating and or stockpiling of demolition material, construction material, construction equipment, machinery, supplies, vehicles, and materials, within any means of egress (exterior or interior) or any fire lane shall be PROHIBITED, no matter how temporary, without consultation with the Fire Marshal's office.

F. The Fire Marshal's office reserves the right to require the posting of fire lanes upon the premises in accordance with State regulations.

G. Provide all signs, barricades, warning lights, and other appurtenances required to maintain traffic and access to parking areas if necessary.

END OF SECTION 02 10 00

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work under this Section includes the excavation of exploratory test pits to determine or verify underground utility or structure locations or other purposes.

1. Test pit excavation under this Section shall be as ordered by the Engineer. Required pre-excavation of the trench as specified elsewhere herein shall not be considered as a test pit for the purposes of this Contract.

2. The work shall include all necessary excavating, disposing of unused excavated material, refilling trenches, furnishing additional material for refilling, temporary paving, permanent surface restoration in non-paved areas, pumping and all incidental work except as otherwise provided for.

B. This item of work is not intended for the general use of the Contractor to verify the location of underground utilities, structures, or service connections for the work shown on the Contract Drawings. Any such work shall be included in the appropriate item for permanent works.

1.2 RELATED WORK

A. Section 31 20 00, “Earth Moving”

B. Section 31 41 00, “Excavation Support”

C. Section 31 23 19, “Dewatering”

D. Section 32 12 16, “Bituminous Asphalt Concrete Paving”

PART 2 - PRODUCTS

2.1 BANK RUN GRAVEL AND OTHER SPECIAL TRENCH REFILL MATERIALS

A. Refer to Section 31 23 33, “Trenching and Backfilling”.

2.2 TEMPORARY PAVEMENT

A. Refer to Section 32 12 16, “Bituminous Asphalt Concrete Paving”.

PART 3 - EXECUTION

3.1 GENERAL

A. Test pit excavations shall be as ordered by the Engineer and as specified below. The horizontal dimensions of the pit shall be as ordered by the Engineer.

B. The perimeter lines between existing pavement and/or sidewalks to be removed and existing pavement and/or sidewalks to remain shall be carefully cut to leave a smooth, straight, and vertical edge. The methods used and the location of such cuts shall conform to the requirements and specifications of the authorities having jurisdiction. The pavement inside the perimeter lines shall be broken up and removed.

C. Material shall be carefully excavated so that the underground utility or structure being searched for, or any other utility or structure, will not be damaged or destroyed. Excavation shall be with a hand shovel if conditions so warrant. Any utility or structure damaged or destroyed shall be replaced or repaired at no additional cost to the Owner.

D. Support of the excavation and dewatering shall be sufficient to accomplish the purpose of the test pit and be in conformance, where required, with other applicable sections of these Specifications.

E. The Contractor shall be responsible for having an on-site mark-out of all utilities in the area completed prior to digging a test pit in that area.

F. Backfill where the material will be subsequently re-excavated as part of the work under this Contract:

1. The test pit shall be backfilled with suitable bank run gravel material in accord with the requirements of Section 31 23 33.

2. The pavement surface shall receive a temporary patch in accordance with Section 32 12 16.

G. Backfill in areas that will not be subsequently re-excavated as part of the work under this Contract:

1. The test pit shall be backfilled with suitable bank run gravel material as directed by the Engineer in accordance with Section 31 23 33.

2. The pavement surface shall receive a temporary patch in accordance with Section 32 12 16.

3. The pavement surface shall be permanently restored in accordance with Section 32 12 16.

4. Where unpaved areas are disturbed in the course of test pit excavation, restoration shall be in accordance with Section 31 23 00, Section 32 91 19, and Section 32 92 00.

3.2 SERVICE CONNECTION OR UTILITY VERIFICATION

A. Tests may be carried out to verify the location and type of service connections or utilities or for other purposes as determined by the Engineer.

B. Test pits at utility crossings shall be utilized to determine if the crossing can be made at the location indicated on the plans or as directed by the Engineer. If the crossing is to take place at a pipe joint in the utility, the location of the crossing shall be revised so that it will not occur at a joint as directed by the Engineer.

3.3 NUMBER OF TEST PITS

A. The Contractor shall include in their Base Bid the number of test pits in accordance with the following schedule.

1. 0’ – 10’ Deep: 8 Test Pits

END SECTION 02 32 19

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide all labor, materials, necessary equipment and services to complete the concrete reinforcement work, including but not necessarily limited to the following:

1. Furnishing and placing of:

a. Deformed bar reinforcing.
b. Welded wire fabric.
c. Chairs, supports, ties and miscellaneous hardware for holding reinforcing in place.

1.2 SUBMITTALS

A. Shop drawings for all reinforcing steel shall be submitted. Drawings shall show bending diagrams, splicing and laps of bars, shapes, dimensions, details of bar reinforcing, and accessories. Shop drawings must be reviewed by the Engineer before proceeding with the work.

B. Review of Shop Drawings will only be for sizes and spacing of reinforcement and will not cover detailed fabricating dimensions.

C. All concrete walls shall be drawn in elevation at a minimum of one quarter inch per foot scale showing all wall reinforcing and openings.

D. Structural drawings or sections shall not be reproduced on shop drawings.

E. Connecticut High Performance Building Submittals:

1. Recycled Content: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

1.3 QUALITY ASSURANCE

A. All work of this section shall be provided in accordance with the latest edition of the following standards that are considered to be a part of this specification the same as if fully set forth herein.

1. Building Code Requirements for Reinforced Concrete (ACI 318).
2. Specifications for Structural Concrete for Buildings (ACI 301).
3. 2018 State of Connecticut Building Code.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Material shall conform to the latest requirements of the ASTM Standard Specifications serial designated below and manufactured in the United States.

1. A615 Grade 60 for all bar reinforcing.
2. A185 for Welded Steel Wire Fabric for Concrete Reinforcement.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

PART 3 - EXECUTION

3.1 FABRICATION

A. Reinforcement shall be accurately formed in the shapes and dimensions shown on the drawings and approved schedules.

B. Reinforcement shall be shop fabricated. No field bending or re-bending or cutting will be permitted.

C. All material shall bear mill identification symbol, and be stored so that different sizes may be identified.

D. Wire mesh reinforcing shall be delivered in sheets.

E. All wire mesh and bar reinforcing used for exterior sidewalks or concrete pavements shall be epoxy coated.

3.2 INSTALLATION

A. All reinforcement shall be installed in accordance with ACI 318, ACI 301 and the Connecticut Building Code.

B. Reinforcing shall be delivered and stored at the site in a manner that will protect material from damage.

C. When required or permitted all welding of reinforcing bars shall conform to AWS D1.4. Welding electrode used shall be compatible with Grade 60 reinforcing and the base metal specified.

D. When required or permitted, mechanical connections shall be installed in accordance with the splice device manufacturer's recommendations.

END OF SECTION 03 21 00

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.

B. The latest edition of referenced requirements shall apply.

1.2 DESCRIPTION OF WORK

A. Provide all labor, materials, necessary equipment and services to complete the concrete formwork and cast-in-place concrete work as indicated on the drawings, specified herein or both.

1. Forms for footings, walls, slabs, and any other concrete as shown on the drawings, or specified herein.
2. Furnishing, placing and finishing of cast-in-place concrete for footings, walls, slabs and any other concrete as shown on the drawings or specified herein.
3. Placing of cast-in-items such as anchor bolts, angles, clips, anchors, , and the like furnished under this and other sections.
4. Vapor Barriers.

B. Related Work: The following sections contain requirements that may apply to this section:

1. Division 2 Section "Earth Moving".
2. Division 3 Section "Concrete Reinforcement".

1.3 SUBMITTALS

A. Submit sand and coarse aggregate source and physical properties.

B. Submit laboratories trial mix designs proposed in accordance with Method 1, ACI 301 or one copy each of 30 consecutive test results and the mix design used from a record of past performance in accordance with ACI 301, Method 2.

C. The contractor shall submit the mix designs for approval at least ten (10) days before commencing any concrete operations.

D. Submit catalog cuts and/or appropriate descriptive material and test results for the following:

1. Curing and hardening compounds.
2. Air entrapment admixtures.
3. Non-Shrink grout.

E. Submit procedures for protecting concrete during placement and curing if required.

F. Connecticut High Performance Building Submittals:

1. Recycled Content: For products having recycled content, documentation indicating percentages by weight of postconsumer and pre consumer recycled content. Include statement indicating costs for each product having recycled content.

2. VOC Content: For liquid floor treatments and sealing compounds, documentation including printed statement of VOC content.

1.4 QUALITY ASSURANCE

A. All work of this section shall be provided in accordance with the latest edition of the following standards which are considered to be a part of this specification the same as if fully set forth herein:

1. Specifications for Structural Concrete for Buildings ACI 301.
2. Building Code Requirements for Reinforced Concrete ACI 318.
3. 2018 State of Connecticut Building Code.

B. It is the intent of this specification to secure for every part of the work, concrete of homogeneous nature which, when hardened, will have the required strength, resistance to weathering, and such other qualities as the type of structure or its location may require.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cement shall be Portland Cement, Type I or II conforming to ASTM C150. Cement used in the work shall correspond to that upon which the selection of concrete proportions was based.

B. Hi-early cement shall be used only with prior approval from the Engineer.

C. Concrete admixtures: provide admixtures produced and serviced by established, reputable manufacturer's recommendations.

1. Air-entraining admixtures shall conform to ASTM C260. Water-reducing, set-controlling admixture shall conform to ASTM C494, Type A (water-reducing), Type D (water-reducing and retarding) and Type E (water-reducing, accelerating), Type F or G (high range water-reducing, superplasticizer).
2. Admixtures containing calcium chloride or Thiocyanate shall not be used.
3. Field Service: a qualified concrete technician employed by the manufacturer shall be available to assist in proportioning concrete materials for optimum use, to advise on proper use of the admixture and adjustment of concrete mix proportions to meet job site and climatic conditions.
4.

D. Aggregate:

1. Fine aggregate shall conform to ASTM C33 and be clean, sharp, natural sand, free from loam, clay lumps, or other deleterious substance, within allowable standards.
2. Coarse aggregate for normal weight concrete shall conform to ASTM C33 for normal weight concrete. All aggregate shall be clean, uncoated, graded aggregate, containing no clay, mud, loam, or foreign matter.

E. Water shall be fresh, clean, and drinkable.

F. Curing materials for walls shall conform to the requirement of ASTM C309 "Standard Specifications for Liquid Membrane Forming Compounds for Curing Concrete."

1. Materials shall provide water retention not exceeding loss of .055 gm/sq. cm. when used at a coverage of 450 sq. ft. per gallon.

G. Vapor Barrier:

1. Vapor barrier to be provided under all interior slabs on grade.
2. Vapor barrier shall meet ASTM D4397 and be a minimum of 15-mils.
3. Vapor Barrier Products:

   a. Stego Wrap (15 mil) Vapor Barrier by STEGO INDUSTRIES LLC, San Juan Capistrano, CA
   (877) 464-7834 www.stegoindustries.com

   b. Griffolyn 15 Mil. Green Vapor Barrier by REEF INDUSTRIES, INC., Houston, TX
   (713) 507-4200 www.reefindustries.com

   c. Perminator (15 mil.) Vapor barrier by W.R. Meadows.

4. Vapor barrier shall be installed in strict conformance with the manufacturer's standards and recommendations.
5. Vapor barrier to be provided under all interior slabs on grade, and shall be installed in strict conformance with the manufacturer's standards and recommendations.
6. Furnish in widest practical widths, lapping joints at least 6". Seal joints with 3" wide tape. Tape around all penetrations. Care shall be taken so as not to damage vapor barrier while doing other work. All tears and punctures shall be repaired prior to placement of concrete at no additional cost to the Owner.

H. Sealers:

1. All exposed concrete slabs shall be sealed with a VOC compliant, 30 percent solids content minimum sealer meeting ASTM C-1315 .
2. Floor sealers are to be applied in accordance with manufacturer's recommendations. The Contractor is responsible to ensure that the sealer is compatible with adhesives and mastics that are to be utilized under other sections of work.

3. **Sealers are not to be used at polished concrete locations, or floors to receive epoxy finishes. Coordinate with Architectural Drawings.**
4. See Section 017830 WARRANTIES AND BONDS for warrantee requirements.

I. Expansion Joint filler:

1. ASTM D1751.
2. Install in sizes as shown on the drawings in accordance with manufacturer's recommendations.

J. Curing blankets for all flatwork.

PART 3 - EXECUTION

3.1 PROPORTIONING OF CONCRETE

A. Concrete shall be composed of Portland cement, fine aggregate, coarse aggregate, water, a water-reducing admixture, and an air-entraining admixture.

B. Proportions of ingredients shall produce concrete which will work readily into corners and angles of forms, and bond to reinforcement without segregation or excessive bleed water forming on the surface. Proportioning of materials shall be in accordance with ACI 211.1.

C. Required Average Strength: Determinations of required average strength (f'c) above specified strength shall be in accordance with ACI 318 and evaluations of compressive strength results of field concrete shall be in accordance with ACI 214.

3.2 REQUIRED CONCRETE QUALITIES

A. Specified Compressive Strength at 28 days shall be **4,000 psi** for all concrete see below for additional information.

1. All footings and walls: (Normal weight with air)

2. Slabs on grade: (Normal weight)

3. **All concrete paving to be ConnDot Class F. 4400 PSI**. Coordinate locations with landscape drawings.

B. Concrete subject to exposure shall be air-entrained. Total air content required (air-entrained and entrapped air) shall be 5% +/- 1% for 3/4" coarse aggregate.

C. Concrete shall be proportioned and produced to have a maximum slump of 4 inches unless a superplasticizer is used. A maximum slump of 6" shall be allowed if a superplasticizer is used. Consolidation shall be by means of vibrators.

D. Maximum size of coarse aggregate shall not exceed 3/4".

E. Concrete shall be adjusted to produce the required rate of hardening for varied climatic and job site conditions.

1. Under 50o F. ambient temperature - Accelerate (approval in writing required from the Engineer) (Type E admixture - ASTM C494).
2. Over 80o F. ambient temperature - Retard (Type D admixture ASTM C494).
3. Between 50o F. and 80o F. - Normal Rate of Hardening (Type A admixture - ASTM C494).

3.3 FORMWORK PREPARATION

A. Forms shall be used to confine and shape concrete to required dimensions. Forms shall have sufficient strength to withstand forces from placement and vibration of the concrete, and sufficient rigidity to maintain specified tolerances.

B. Design, engineering, and construction of the formwork shall be the responsibility of the Contractor.

C. Work shall be designed for loads, lateral pressure and allowable stresses in accordance with ACI 347, "Recommended Practice for Concrete Formwork."

D. All tolerances, preparation of form surfaces, removal of forms etc. shall be in accordance with chapter 4 of ACI 301.

E. Construction joints shall be located only where approved by the Engineer.

3.4 CONCRETE PLACEMENT

A. Formwork shall have been completed and all snow, ice, water, and debris removed from within forms.

B. Expansion joint material, anchors and all embedded items shall have been positioned.

C. Subgrades shall be sprinkled sufficiently to eliminate water loss from the concrete.

D. Concrete shall not be placed on frozen ground.

E. Concrete shall be ready-mixed, batched, mixed and transported in accordance with ASTM C94.

F. Preparations: Contractor shall provide access for delivery and provide sufficient equipment and manpower to rapidly place all concrete.

G. Conveying: Concrete shall be handled from mixer to final deposit rapidly by methods which will prevent segregation or loss of ingredients to maintain required quality of concrete. It shall be placed in the forms or on grade as near as practicable to its final position and shall be prohibited from free falling more than 4 feet.

H. Concrete shall be deposited continuously; when continuous placement is not possible, construction joints shall be located as approved by the Engineer. Concrete shall be placed as nearly as possible to its final position. Avoid rehandling or flowing.

I. Cold Weather: When ambient temperatures are below 40F, or at 45F and falling, the requirements of ACI 306R "Recommended Practice for Cold Weather Concreting" shall be followed.

1. Temperature of concrete delivered at the job site shall comply with the requirements of ACI 306R, "Cold Weather Concreting."

2. Concrete temperature shall be maintained during cold weather for the recommended period of time specified in Table 1.4.2 in A.C.I. 306R.

3. Special attention shall be given to the corners and edges of concrete during cold weather to prevent damage.

4. Provisions shall be made to retain heat by using insulating blankets or by an outside heat source.

J. Hot Weather: When ambient temperatures are at or above 75F or at 70F and rising, the requirements of ACI 305R "Recommended Practice for Hot Weather Concreting" shall be followed.

1. The temperature of concrete delivered at the job site shall comply with the requirements of ACI 305R,

K. Curing and Protection: Immediately following placement, concrete shall be protected from premature drying, hot and cold temperatures, rain, flowing water and mechanical injury. Materials and method of curing shall be approved by the Engineer**. THE USE OF CURING COMPOUNDS ON FLATWORK WILL NOT BE ACCEPTED. ALL FLAT WORK SHALL BE WET CURED A MINIMUM OF 7 DAYS.**

L. Vertical and Overhead Surface Finishes:

1. Unfinished areas: Vertical and overhead concrete surfaces exposed in pipe basements, elevator and dumbwaiter shafts, pipe spaces, pipe trenches, above suspended ceilings, manholes, and other unfinished areas will not require additional finishing.

2. Interior and exterior exposed areas to be painted: Remove fins, burrs and similar projections on surfaces flush, and smooth by mechanical means approved by Engineer, and by rubbing lightly with a fine abrasive stone or hone. Use ample water during rubbing without working up a lather of mortar or changing texture of concrete.

3. Interior and exterior exposed areas finished: Give a grout finish of uniform color and smooth finish treated as follows:

a. After concrete has hardened and laitance, fins and burrs removed, scrub concrete with wire brushes. Clean stained concrete surfaces by use of a hone stone.
b. Grout mix composed of one part of Portland cement, 1.5 parts fine sand, bonding admixture, and water at a 50:50 ratio. Mix to achieve the consistency of thick paint. Work grout into surface of concrete with cork floats or fiber brushes until all pits, and honeycombs are filled.
c. After grout has hardened slightly, but while still plastic, scrape grout off with a sponge rubber float and, about one hour later, rub concrete vigorously with burlap to remove any excess grout remaining on surfaces.
d. In hot, dry weather use a fog spray to keep grout wet during setting period. Complete finish of area in same day. Make limits of finished areas at natural breaks in wall surface. Leave no grout on concrete surface overnight.

4. Textured: Finish as specified. Maximum quantity of patched area 2 square feet in each 1,000 square feet of textured surface.

M. Slab Finishes:

1. Monitoring and Adjustment: Provide continuous cycle of placement, measurement, evaluation and adjustment of procedures to produce slabs within specified tolerances. Monitor elevations of structural steel in key locations before and after concrete placement to establish typical deflection patterns for the structural steel. Determine elevations of cast-in-place slab soffits prior to removal of shores. Provide information to Engineer and floor consultant for evaluation and recommendations for subsequent placements.

2. Set perimeter forms to serve as screed using either optical or laser instruments. For slabs on grade, wet screeds may be used to establish initial grade during strikeoff, unless Engineer determines method is proving insufficient to meet required finish tolerances and directs use of rigid screed guides. Where wet screeds are allowed, they shall be placed using grade stakes set by optical or laser instruments. Use rigid screed guides, as opposed to wet screeds, to control strikeoff elevation for all types of elevated (non slab-on-grade) slabs. Divide bays into halves or thirds by hard screeds. Adjust as necessary where monitoring of previous placements indicates unshored structural steel deflections to other than a level profile.

3. Place slabs monolithically. Once slab placement commences, complete finishing operations within same day. Slope finished slab to floor drains where they occur, whether shown or not.

4. Use straightedges specifically made for screeding, such as hollow magnesium straightedges or power strikeoffs. Do not use pieces of dimensioned lumber. Strike off and screed slab to a true surface at required elevations. Use optical or laser instruments to check concrete finished surface grade after strikeoff. Repeat strikeoff as necessary. Complete screeding before any excess moisture or bleeding water is present on surface. Do not sprinkle dry cement on the surface.

5. Immediately following screeding, and before any bleed water appears, use a 10-foot wide highway straightedge in a cutting and filling operation to achieve surface flatness. Do not use bull floats or darbys, except that darbying may be allowed for narrow slabs and restricted spaces.

6. Wait until water sheen disappears and surface stiffens before proceeding further. Do not perform subsequent operations until concrete will sustain foot pressure with maximum of 1/4-inch indentation.

7. Scratch Finish: Finish base slab to receive a bonded applied cementitious application as indicated above, except that bull floats and darbys may be used. Thoroughly coarse wire broom within two hours after placing to roughen slab surface to insure a permanent bond between base slab and applied materials.

8. Float Finish: Slabs to receive a steel trowel finish, fill, mortar setting beds, or a built-up roof, and ramps, stair treads, platforms (interior and exterior), and equipment pads shall be floated to a smooth, dense uniform, sandy textured finish. During floating, while surface is still soft, check surface for flatness using a 10-foot highway straightedge. Correct high spots by cutting down and correct low spots by filling in with material of same composition as floor finish. Remove any surface projections and refloat to a uniform texture.

9. Steel Trowel Finish: Concrete surfaces to receive resilient floor covering or carpet, monolithic floor slabs to be exposed to view in finished work, future floor roof slabs, applied toppings, and other interior surfaces for which no other finish is indicated. Steel trowel immediately following floating. During final troweling, tilt steel trowel at a slight angle and exert heavy pressure to compact cement paste and form a dense, smooth surface. Finished surface shall be smooth, free of trowel marks, and uniform in texture and appearance.

10. Broom Finish: Finish exterior slabs, ramps, and stair treads with a bristle brush moistened with clear water after surfaces have been floated. Brush in a direction transverse to main traffic. Match texture approved by Resident Engineer from sample panel.

11. Finished slab flatness (FF) and levelness (FL) values comply with the following minimum requirements:

    a. Areas covered with carpeting, or not specified otherwise below:

    Slab on grade
    Specified overall value.....F_F 25/F_L 20
    Minimum local value.....F_F 17/F_L 15

    Level tolerance such that 80 percent of all points fall within a 3/4-inch envelope (+3/8-inch, -3/8-inch) from the design elevation.

b. Areas that will be exposed, receive thin-set tile or resilient flooring, or roof areas designed as future floors:

Slab on grade
Specified overall value.....F_F 36/F_L 20
Minimum local value.....F_F 24/F_L 15

Level tolerance such that 80 percent of all points fall within a 3/4-inch envelope (+3/8-inch, -3/8-inch) from the design elevation.

a. "Specified overall value" is based on the composite of all measured values in a placement derived in accordance with ASTM E1155.

12. Measurements:

a. Retained testing laboratory will take measurements as directed by Engineer, to verify compliance with FF, FL, and other finish requirements. Measurements will occur within 72 hours after completion of concrete placement (weekends and holidays excluded). Profile data for above characteristics may be collected using a laser level or any Type II apparatus (ASTM E1155, "profileograph" or "dipstick"). Contractor's surveyor shall establish reference elevations to be used by retained testing laboratory.

13. Contractor not experienced in using FF and FL criteria is required to retain the services of a floor consultant to assist with recommendations concerning adjustments to slab thicknesses and procedures on measurements of the finish as it progresses in order to achieve the specific flatness and levelness numbers.

14. Acceptance/ Rejection:

a. If individual slab section measures less than either of specified minimum local FF/FL numbers, that section shall be rejected and remedial measures shall be required. Sectional boundaries may be set at construction and contraction (control) joints, and not smaller than one-half bay.
b. If composite value of entire slab installation, combination of all local results, measures less than either of specified overall FF/FL numbers, then whole slab shall be rejected and remedial measures shall be required.

15. Remedial Measures for Rejected Slabs: Correct rejected slab areas by grinding, planing, surface repair with underlayment compound or repair topping, retopping, or removal and replacement of entire rejected slab areas, as directed by Engineer, until a slab finish constructed within specified tolerances is accepted.

N. Repair of Surface Defects: All surface defects shall be repaired immediately after form removal according to Chapter 9 of the ACI 301.

O. Do not place concrete when weather conditions prevent proper placement and consolidation, or when concrete has attained its initial set, or has contained its water or cement content for more than 1-1/2 hours.

3.5 TESTING AND INSPECTION

A. Materials and operations shall be tested and inspected as work progresses. Failure to detect defective work shall not prevent rejections when defect is discovered.

B. The following testing services shall be performed by the testing laboratory selected and paid for by the Owner:

1. Mold and cure four specimens from each sample of concrete.

2. Test specimens in accordance with "Method of Test for Compressive Strength of Molded Concrete Cylinders," ASTM C39. Two specimens shall be tested at 28 days for acceptance and one shall be tested at 7 days for information. An additional cylinder shall be made as an extra in case a 56-day break is required.

3. Make one strength test for each 50 cu. yds. or fraction thereof, but not less than one set of cylinders per 3500 SF of floor or wall area or fraction there of, of each mix design of concrete placed in any one day. (One test consists of 4 cylinders.)

4. Determine slump, air content and temperature for each strength test and whenever consistency of concrete appears to vary.

5. All sampling of pumped concrete shall be done at the discharge end of the pump lines.

6. Testing laboratory to provide for measurements of slab finish as required by Engineer and as described in Section 3.04, item M.12.a.

C. To facilitate testing and inspection, the contractor shall:
1. Furnish necessary labor to assist testing agency in obtaining and handling samples at the job site.

D. Owner agrees to pay for the above tests with the exception of work that is found to be defective. Subsequent tests shall be taken and paid for by the contractor.

E. During cold weather additional weather information shall be recorded including temperatures at several points within the enclosure and on the concrete surface, corners, and edges to show range of values. See Chapter 9 of A.C.I. 306R.

END OF SECTION 03 30 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The General Conditions and Supplementary General Conditions apply to this Section of the Specification.

1.2 SUMMARY

A. Provide all labor, materials, tools and equipment, as and when required to perform the work specified herein or as shown on the plans.

B. Material and procedures for fabricating and installing single cell precast concrete box culverts, multi-cell precast concrete box culverts, precast conventionally reinforced concrete three-sided culvert structures, and ancillary appurtenances such as cutoff walls, aprons, footings, floor slabs, headwalls and wing walls.

1.3 SUBMITTALS

A. Submit proposed concrete mix.

B. Submit manufacturers' descriptive literature for all admixtures.

C. Detailed plans including culvert sizes and wall widths, line layout, joint details and lifting devices.

D. Structural calculations for the precast element. ASTM C 1577 steel areas may be used for box culverts without providing supporting calculations. For special designs, or for sizes and loads other than those shown in Table 1 of ASTM C 1577, engineering calculations shall be required. Engineering calculations shall be performed using software approved by the American Concrete Pipe Association (currently the ACPA approved software is “ET Culvert”; “Boxcar” is no longer being updated and is not approved for use by ACPA). Engineering calculations shall address the following:

1. Box culverts shall be designed as rigid frame sections with a minimum of two (2) separate continuous cages (inner and outer cages) of steel reinforcement. All other specification requirements such as laps, welds, and tolerances of placement in the wall of the box section shall conform to ASTM C 1577.
2. Load combinations shall be designed in compliance with ASCE 26-97, Section 11
3. Design load criteria shall be designed in compliance with ASTM C 1577, including all notes, commentary, and appendices contained within the specification
4. Crack control shall be designed for a Class 2 Exposure in compliance with AASHTO LRFD Bridge Design Specifications, Sections 5 and 12

E. Provide the seal of a Professional Engineer (PE) licensed in the State of Connecticut on drawings and supporting engineering calculations.

F. Allow the Engineer up to seven calendar days to review and approve working drawings and supporting engineering calculations.

G. Foundation material gradation (for over excavation replacement), bedding material gradation or leveling course gradation will be submitted for the Engineers approval.

1.4 REFERENCES

A. AASHTO LRFD Bridge Design Specifications

B. ASTM C 150: Standard Specification for Portland Cement

C. ASTM C 877: External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections

D. ASTM C 990: Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

E. ASTM C 920: Standard Specification for Elastomeric Joint Sealants

F. ASTM C 1504: Manufacture of Precast Reinforced Concrete Three-Sided Structures for Culverts and Storm Drains

G. ASTM C 1577: Precast Reinforced Concrete Monolithic Box Sections for Culverts, Storm Drains, and Sewers Designed According to AASHTO LRFD.

H. ASCE 26-97: Standard Practice for Direct Design of Buried Precast Concrete Box Sections

I. OSHA

PART 2 – PRODUCTS

2.1 MATERIALS

A. Concrete:

1. Minimum 28 day compressive strength to be 5,000 psi at 28 days.
2. Water/cement ration by weight to be 0.38 maximum.
3. Slump to be 3 inches maximum. Note that if fabricator elects to use superplasticizer in mix, this requirement does not apply.
4. Concrete shall be air-entrained following ASTM C260 non-chloride. Air entrainment shall be 7% +/- 1%.
5. Cement shall be Portland Cement, Type II conforming to ASTM C150. Cement proportions shall be a minimum of 658 lbs./cy.
6. Concrete admixtures shall be produced and serviced by established, reputable manufacturer's recommendations.
    a. Water-reducing, set-controlling admixture shall conform to ASTM C494, Type A (water-reducing), Type D (water-reducing and retarding) and Type E (water-reducing, accelerating), Type F or G (high range water-reducing, superplasticizer).
    b. Admixtures containing calcium chloride or Thiocyanate shall not be used.
7. Aggregate:
    a. Fine aggregate shall conform to ASTM C33 and be clean, sharp, natural sand, free from loam, clay lumps, or other deleterious substance, within allowable standards.

b. Coarse aggregate for normal weight concrete shall conform to ASTM C33 for normal weight concrete. All aggregate shall be clean, uncoated, graded aggregate, containing no clay, mud, loam, or foreign matter. Maximum size of coarse aggregate shall not exceed 1/2".

8. Water shall be fresh, clean, and potable.

B. Precast Reinforcement:

1. All reinforcement steel shall be ASTM A615, Grade 60. Welded wire fabric shall conform to ASTM A-185, Grade 65.

C. Joints:

1. Use tongue and groove joints with a bituminous mastic joint sealant that meets the requirements of ASTM C990.

2. Use a mastic joint sealant with a minimum cross-sectional area of 1 to 1½ square inches.

3. Joint wrap is not required. Use ASTM C877 if joint wrap is specified.

4. Mortar grout is not required.

5. Joints using mastic joint sealant alone are typically not considered water-tight or pressure rated joints. If an application requires water-tight joints, other methods or materials should be specified.

D. Lifting Devices:

1. Provide the number and type of lifting devices required to support the vertical and horizontal forces.

2. Use at least four lifting devices for box culvert and three sided structures.

3. Use a minimum safety factor of 4:1 for lifting inserts used in handling and erection of precast concrete box culverts and three-sided structures.

4. Attach to lifting inserts according to manufactures recommendations.

5. Use a maximum diameter of three (3) inches when lifting holes are used. Locate holes to avoid interference with the reinforcing steel.

2.2 MANUFACTURE

A. Precast Concrete Box Culverts:

1. Meet the requirements in ASTM C 1577.

2. Special designs for sizes and loads other than those shown in Table 1 of ASTM C 1577 require approval by the Engineer.

3. Prepare special designs according to AASHTO LRFD Bridge Design Specifications, Section 12.

2.3 QUALITY ASSURANCE

A. Manufacture of pre-cast concrete box culvert section must be completed in a plant where the quality assurance program has been certified by either the American Concrete Pipe Association (for box culverts).

B. Permanently mark each precast unit with date of casting and supplier identification.

C. Prevent cracking or damage during shipping, handling and storage of precast units.

D. Replace or repair, cracked or damaged precast units at no additional cost to the Owner.

E. Manufacturer shall dry fit box sections in the plant to verify that joints are consistent through the manufacturing process and that the different mating surfaces (i.e. tongue and groove) do not bind during the dry fit test. Dry fitting is defined as placing two box sections together, either vertically or horizontally, without any type of joint sealant in the joints. Dry fitting shall be performed as follows:

1. Wet cast sections: each section shall be tested.
2. Dry cast sections: a minimum of one test shall be performed per size of box per day of production, or twenty percent (20%) of one day's production, rounded up to the nearest whole number, whichever is greater.
3. Dry fit tests shall be documented and kept in the manufacturing plant. Documentation shall be made available upon request of the owner.
4. If the dry fit test shows that the joints are not consistent or the mating surfaces bind, the manufacturer will make the necessary repairs to the products or adjust the manufacturing process necessary to correct the issue.

PART 3 - EXECUTION

Meet all applicable local, state, and federal statutes, regulations, codes, etc., including applicable OSHA standards, in the construction of box culverts, and ancillary appurtenances.

3.1 BEDDING AND BACKFILL

A. Over-excavate the material under the box location in compliance with the project specifications to a minimum depth of six (6) inches.

1. Where unstable material is encountered below the plan foundation, it should be removed to the depth and width directed by the Engineer and replaced.
2. Rock/boulders encountered at the bedding level (within six inches from the bottom of the box) must be removed and replaced.
3. Replace over-excavated material with granular backfill borrow or free draining granular material.
4. Provide a minimum bedding of six (6) inches of granular backfill borrow or free draining granular material.
5. Limit soil gradations for bedding material to a ¾-inch maximum particle size.

B. Provide a two-inch leveling course in addition to the bedding material.

1. Excavate the area to the appropriate depth to accommodate the backfill and leveling course.
2. The leveling course will have a maximum particle size of 3/8-inch.

3. If the bedding material has voids after compaction, then a filter fabric will be required to separate the leveling course from the bedding material.

C. Level and compact bedding material to provide uniform support of the structure along its entire supported width and length. Verify alignment and grade requirement with a laser instrument set on a solid surface outside of the box. Check alignment of each section that is set. Check final grade of bedding to meet the grade required in the plans. The grade will be checked every two feet along the longitudinal alignment of the box culvert, in two foot increments to either side of the center line extending one foot wider than the outside wall of the box culvert (i.e., a two-foot square grid over the entire bedding). Use a large landscaping rake or board to check the grade in between the survey points.

D. Backfill structure as shown in the plans. Backfill in uniform lifts on each side of the structure. Do not disturb the alignment of the boxes.

E. Refer to project plans for excavation, bedding, and backfill requirements where a three-sided culvert structure is placed on a footing.

F. Backfill the gap between multiple single-cell culverts with the material specified on the plans.

3.2 INSTALLATION

A. Inspect precast elements for defects before lowering into trench.

B. Repair or replace any defective, damaged or unsound precast elements.

C. Use a trench width adequate to place and compact bedding material.

D. Adjust the lifting cables so that the box hangs to meet the specific slope of the channel where longitudinal slope is encountered.

E. Lay precast elements starting at the downstream end and working upstream. Place the bell (groove) of the box upstream.

F. Carefully lower precast elements into the trench with suitable equipment to prevent damage.

G. Remove all dirt and foreign material from joints. Prevent dirt and material from re-entering joints. Joint walls must be clean, dry, frost-free, and free of oil and grease and any other contaminants.

H. For box culverts, a small transverse trench (shovel width wide by at least three inches deep by the width of the box culvert) should be formed at the end of the last installed box culvert section to allow material to fall into when the next box section is pulled into place.

I. Apply joint sealant furnished by manufacturer.

1. Place the joint material on the bottom of the groove (bell) of the box last placed. Place this material against the shoulder of the groove (bell).

2. Place the balance of the joint material on top of the tongue (spigot) and down the sides of the tongue (spigot) of the box to be set. Place the joint material about one inch from the leading edge of the tongue (spigot).

3. Place the joint material so that there are no voids and so that the joint material from the bell overlaps the joint material on the spigot. This overlap shall be at least ½-inch but no more than one inch.

4. Use a winter grade joint material when constructing in temperatures less than 50 degrees.

J. Do not attempt to force box culverts to grade.

K. Disassemble joint, check position of joint sealant, reapply new joint sealant if necessary, repair alignment, and re-install when adjoining elements cannot be pulled together to meet minimum joint requirements.

L. Pull sections home to ½-inch joint gap spacing (measured face to face of adjoining concrete surfaces). In cases where it is necessary to adjust the total length or alignment of a run of box culvert, the Engineer can approve up to a one (1) inch joint gap spacing.

M. Check the lay length of each section where necessary to make sure that cut-off walls, head walls, special precast sections, etc. are properly placed. Different joint gaps than the project line lay out can cause the project length to increase/decrease.

N. Two pulling inserts are installed in each box culvert section. Use the pulling inserts to attach chains and come-along devices from the previously set box culvert to the next box culvert. Use chains and come along devices to pull the box culvert home evenly to the tolerances shown above.

O. Do not disturb previously completed joints during laying operation. After the initial two box culvert sections are set, the come-along device, must remain in place over three box culvert sections or span at least three box culvert sections while progressing along the alignment. Recheck previously completed sections to make sure they are not pulled apart after they have been set.

P. Keep the majority of the box weight on the lifting devices and gradually pull the box home until it meets joint gap spacing. Gradually, let the box down on the bedding. If the joint gap is not within the specification, the box should be lifted slightly and pulled again.

Q. Construction equipment such as backhoes, front end loaders, etc., must not be used to push the box culvert home.

R. Alternatives for pulling box culvert sections together must be approved by the Engineer.

S. Do not lay precast elements when water is in the trench.

3.3 CONNECTION TO CAST-IN-PLACE CONCRETE

A. Project the reinforcing steel at least twelve (12) inches out of the precast box section and square off the concrete face where precast box sections join cast-in-place concrete.

B. All reinforcement shall have a minimum of 2” coverage.

C. Patching will be acceptable providing the structural adequacy of the product and the appearance is not impaired.

D. Transportation, site handling, and erection shall be performed with acceptable equipment and methods, and by qualified personnel.

END OF SECTION 03 40 00

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. Architectural precast concrete wall copings for site walls.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for installing connection anchors in concrete.
2. Division 4 Section "Unit Masonry Assemblies" for the following:
    a. Wall sample panel that includes products provided as part of the Work of this Section.
    b. Coordination of installation of brick veneer with installation of architectural precast concrete coping units.
    c. Mortar used incidental to the installation of architectural precast concrete units.
    d. Compressible filler, weep/vent and cavity drainage material.
3. Division 7 Section “Joint Sealants” for elastomeric joint sealants and sealant backings for applications including, but not limited to, sealing of joints between precast concrete panels to the extant not specified in this Section.

1.3 DEFINITION

A. Design Reference Sample: Sample of approved architectural precast concrete color, finish and texture, preapproved by Architect.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide architectural precast concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:

1. Thermal Movements: Provide for in-plane thermal movements resulting from annual ambient temperature changes of 120 deg F.

1.6 SUBMITTALS

A. Product Data: For each type of product.

B. Connecticut High Performance Building Submittals:

1. Recycled Content Materials
2. Local or Regional Materials

C. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.

D. Samples: For each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of three, indicating full range of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches (300 by 300 by 50 mm).

1. When other faces of precast concrete unit are exposed, include Samples illustrating workmanship, color, and texture of backup concrete as well as facing concrete.

E. Welding certificates.

F. Qualification Data for fabricator. Submit data evidencing that fabricator participates in PCI Plant Certification program at time of bidding and is certified by PCI to produce precast concrete fabrications of the scope, finish and complexity required for this Project. Include the following:

1. Certification prepared by PCI for A1 level fabrication of architectural precast concrete of the scope, finish and complexity required for this Project.

G. Qualification Data for Installer. Submit data showing that Installer is qualified according to the requirements of "Quality Assurance" article below to erect architectural precast concrete systems of the type and complexity required for this Project.

H. Qualification Data for Testing Agency. Submit data evidencing that Testing Agency is qualified according to requirements of "Quality Assurance" article below.

I. Material Certificates: For the following items:

1. Cementitious materials.
2. Reinforcing materials and prestressing tendons.
3. Admixtures.
4. Bearing pads.
5. Stone anchors.

J. Material Test Reports: For aggregates.

K. Source quality-control test reports.

L. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."

B. Design Standards: Comply with ACI 318 and design recommendations of PCI MNL 120 "PCI Design Handbook – Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.

C. Mockups: After sample panel and range sample approval but before production of architectural precast concrete units, construct full-sized mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockup as indicated on Drawings including sealants and architectural precast concrete complete with anchors, connections, flashings, and joint fillers.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Remove mockups when directed by Architect.

1.8 COORDINATION

A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction without delaying the Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver architectural precast concrete units in such quantities and at such times to limit unloading units temporarily on the ground or other rehandling.

B. Support units during shipment on nonstaining shock-absorbing material.

C. Store units with adequate dunnage and bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.

D. Place stored units so identification marks are clearly visible, and units can be inspected.

E. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.

F. Lift and support units only at designated points indicated on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Wausaumade, Rothschild, WI (800) 388-8728 www.wausaumade.com

B. Northern Design Precast & Cast Stone, Loudon, NH (603) 783-8989 http://ndprecast.com/

C. MGA Cast Stone, Oxford, ME (207) 539-6035 www.mgacaststone.com

D. Durastone, New Gloucester, ME (207) 926-5704 www.durastone.us

2.2 FINISHES

A. Coping pieces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved sample panels and as follows:

1. PCI's "Architectural Precast Concrete – Color and Texture Selection Guide, with the following requirement:
    a. Match existing precast coping at the new school site similar to buff colored Indiana Limestone. Color of cement and aggregates to be selected by the Architect from manufacturer's full range including standard colors, premium colors, and custom colors. The existing precast was supplied to the school project by Northern Design Precast and Cast Stone of Loudon, NH.

b. Sandblasted: Medium.

2. Finish exposed surfaces and edges of architectural precast concrete units to match face-surface finish.

3. Finish unexposed surfaces of architectural precast concrete units by float finish.

2.3 MOLD MATERIALS

A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that provides continuous and true precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.

1. Mold-Release Agent: Commercially produced form-release agent that does not bond with, stain or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.

2.4 REINFORCING MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Galvanized Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed bars, with ASTM A 767/A 767M, Class II zinc coating and chromate treatment. Galvanize after fabrication and bending.

C. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 hs galvanized deformed bars, assembled with clips.

D. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from galvanized-steel wire into flat sheets.

E. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

2.5 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or Type III, gray, unless otherwise indicated.

1. For surfaces exposed to view in finished structure, use gray or white cement, of same type, brand, and mill source.

B. Supplementary Cementitious Materials:

1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.

2. Metakaolin: ASTM C 618, Class N.

3. Silica Fume: ASTM C 1240, with optional chemical and physical requirement.

4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33/C 33M, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

1. Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.

a. Gradation: Uniformly graded.

2. Fine Aggregates: Selected, natural or manufactured sand compatible with coarse aggregate; to match approved finish sample.

D. Coloring Admixture: ASTM C 979/C 979M, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.

E. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 117.

F. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

G. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15 percent chloride ions or other salts by weight of admixture.

1. Water-Reducing Admixtures: ASTM C 494/C 494M, Type A.

2. Retarding Admixture: ASTM C 494/C 494M, Type B.

3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.

4. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.

5. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.

6. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.

7. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 STAINLESS-STEEL CONNECTION MATERIALS

A. Stainless-Steel Plate: ASTM A 666, Type 304.

B. Stainless-Steel Bolts: ASTM F 593, Alloy 304 hex-head bolts and studs; ASTM F 594, stainless-steel nuts; and flat, stainless-steel washers.

1. Lubricate threaded parts of stainless-steel bolts with an antiseize thread lubricant during assembly.

2.7 ACCESSORIES

A. Reglets: Specified in Division 7 "Sheet Metal Flashing and Trim."

B. Precast Accessories: Provide clips, hangers, high-density plastic or steel shims, and other accessories required to install architectural precast concrete units.

2.8 GROUT MATERIALS

A. Sand-Cement Grout: Portland cement, ASTM C 150/C 150M, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C 1218/C 1218M.

B. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C 1107/C 1107M, Grade A for drypack and

Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06 percent by weight of cement when tested according to ASTM C 1218/C 1218M.

C. Epoxy-Resin Grout: Two-component, mineral-filled epoxy resin; ASTM C 881/C 881M, of type, grade, and class to suit requirements.

2.9 CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.

B. Limit use of fly ash and ground granulated blast-furnace slag to 20 percent of portland cement by weight; limit metakaolin and silica fume to 10 percent of portland cement by weight.

C. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.

D. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 (ACI 318M) or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.

E. Normal-Weight Concrete Mixtures: Proportion full-depth mixture by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 5000 psi (34.5 MPa) minimum.

2. Maximum Water-Cementitious Materials Ratio: 0.45.

F. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to ASTM C 642, except for boiling requirement.

G. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.

H. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.

2.10 MOLD FABRICATION

A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.

B. Maintain molds to provide completed architectural precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.

1. Form joints are not permitted on faces exposed to view in the finished work.

2. Edge and Corner Treatment: Uniformly: As indicated.

2.11 FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.

C. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on the Contract Drawings.

D. Cast-in openings larger than 10 inches (250 mm) in any dimension. Do not drill or cut openings or prestressing strand without Architect's approval.

E. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcing exceeds limits specified in ASTM A 775/A 775M, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.

2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.

3. Place reinforcing steel and prestressing strands to maintain at least 3/4-inch (19-mm) minimum concrete cover. Increase cover requirements for reinforcing steel to 1-1/2 inches (38 mm) when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.

4. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.

F. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses and specified in-place loads.

1. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.

G. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

H. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.

I. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 117.

J. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.

K. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure

units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

L. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.

2.12 FABRICATION TOLERANCES

A. Fabricate architectural precast concrete units to shapes, lines, and dimensions indicated so each finished unit complies with the following product tolerances:

1. Overall Height and Width of Units, Measured at the Face Exposed to View: As follows:
   a. 10 feet (3 m) or under, plus or minus 1/8 inch (3 mm).
2. Overall Height and Width of Units, Measured at the Face Not Exposed to View: As follows:
   a. 10 feet (3 m) or under, plus or minus 1/4 inch (6 mm).
3. Total Thickness or Flange Thickness: Plus 1/4 inch (6 mm), minus 1/8 inch (3 mm).
4. Variation from Square or Designated Skew (Difference in Length of the Two Diagonal Measurements): Plus or minus 1/8 inch/72 inches (3 mm/1830 mm) or 1/2 inch (13 mm) total, whichever is greater.
5. Bowing: Plus or minus L/360, maximum 1 inch (25 mm).
6. Local Smoothness: 1/4 inch/10 feet (6 mm/3 m).
7. Warping: 1/16 inch/12 inches (1.5 mm/300 mm) of distance from nearest adjacent corner.
8. Dimensions of Architectural Features and Rustications: Plus or minus 1/8 inch (3 mm).

B. Position Tolerances: For cast-in items measured from datum line location, as indicated on Shop Drawings.

1. Inserts: Plus or minus 1/2 inch (13 mm).
2. Handling Devices: Plus or minus 3 inches (75 mm).
3. Reinforcing Steel and Welded Wire Reinforcement: Plus or minus 1/4 inch (6 mm) where position has structural implications or affects concrete cover; otherwise, plus or minus 1/2 inch (13 mm).

2.13 SOURCE QUALITY CONTROL

A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6.

B. Owner will employ an independent testing agency to evaluate architectural precast concrete fabricator's quality-control and testing methods.

1. Allow Owner's testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with Owner's testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.

C. Strength of precast concrete units is considered deficient if units fail to comply with ACI 318 (ACI 318M) requirements for concrete strength.

D. Testing: If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 (ACI 318M) requirements, precaster will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M and ACI 318 (ACI 318M).

1. A minimum of three representative cores shall be taken from units of suspect strength, from locations directed by Architect.

2. Test cores in an air-dry condition.

3. Strength of concrete for each series of three cores is considered satisfactory if average compressive strength is equal to at least 85 percent of 28-day design compressive strength and no single core is less than 75 percent of 28-day design compressive strength.

4. Report test results in writing on same day that tests are performed, with copies to Architect, Contractor, and precast concrete fabricator. Test reports include the following:

   a. Project identification name and number.

   b. Date when tests were performed.

   c. Name of precast concrete fabricator.

   d. Name of concrete testing agency.

   e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.

E. Patching: If core test results are satisfactory and precast concrete units comply with requirements, clean and dampen core holes and solidly fill with precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.

F. Defective Units: Discard and replace recast architectural concrete units that do not comply with acceptability requirements in PCI MNL 117, including concrete strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Architect's approval. Architect reserves the right to reject precast units that do not match approved samples, sample panels, and mockups. Replace unacceptable units with precast concrete units that comply with requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting performance of the Work.

B. Do not install precast concrete units until supporting cast-in-place concrete has attained minimum allowable design compressive strength and supporting steel or other structure is structurally ready to receive loads from precast concrete units.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.

B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment of units until permanent connections are completed.

1. Install temporary steel or plastic spacing shims as precast concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.

2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.

3. Remove projecting lifting devices and grout fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.

4. Unless otherwise indicated, maintain uniform joint widths of 3/4 inch (19 mm).

C. Connect architectural precast concrete units in position as indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

D. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.

1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot.

2. For slip-critical connections, use one of the following methods to assure proper bolt pretension:

a. Turn-of-Nut: According to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

b. Calibrated Wrench: According to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

E. Grouting Connections and Joints: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces. Promptly remove grout material from exposed surfaces before it affects finishes or hardens. Keep grouted joints damp for not less than 24 hours after initial set.

3.3 ERECTION TOLERANCES

A. Erect architectural precast concrete units level, plumb, square, and according to erection tolerances specified in Division 4 “Unit Masonry Assemblies.”.

3.4 FIELD QUALITY CONTROL

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

B. Visually inspect field welds and test according to ASTM E 165 or to ASTM E 709 and ASTM E 1444. High-strength bolted connections are subject to inspections.

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

D. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.

3.5 REPAIRS

A. Repair architectural precast concrete units if permitted by Architect. Architect reserves the right to reject repaired units that do not comply with requirements.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet (6 m).

C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780/A 780M.

D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

E. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.6 CLEANING

A. Clean surfaces of precast concrete units exposed to view.

B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Protect other work from staining or damage due to cleaning operations.

2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION 03 45 00

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 unit masonry assemblies consisting of the following:

1. Concrete masonry units.
2. Face brick.
3. Mortar and grout.
4. Reinforcing steel.
5. Masonry joint reinforcement.
6. Ties and anchors.
7. Embedded flashing.
8. Miscellaneous masonry accessories.
9. Cavity-wall insulation.

B. Refer to Division 1 Section “Contract Considerations” for unit prices applicable to the Work of this Section.

C. Products installed, but not furnished, under this Section include the following:

1. Architectural precast concrete trim, furnished under Division 3 Section "Architectural Precast Concrete."
2. Steel lintels and shelf angles for unit masonry, furnished under Division 5 Section "Metal Fabrications."
3. Manufactured reglets in masonry joints for metal flashing, furnished under Division 7 Section "Sheet Metal Flashing and Trim."
4. Hollow-metal frames in unit masonry openings, furnished under Division 8 Section "Steel Doors and Frames."

1.3 DEFINITIONS

A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 SUBMITTALS

A. Product Data: For each different masonry unit, accessory, and other manufactured product specified.

B. Connecticut High Performance Building Submittals:

1. Recycled Content: Provide data showing postconsumer and preconsumer recycled materials content of materials and fabricated items provided for this project, stated as a

percentage of the materials included in these items or materials provided as part of the Work of this Section.

2. Regional Materials: Provide data showing materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

C. Shop Drawings:

1. Show fabrication and installation details for the following:

a. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.

b. Stone and Cast Stone Trim Units: Show sizes, profiles, and locations of each stone and cast stone trim unit required.

c. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.

d. Exposed Brick Lintels: Detail assembly of components of exposeded brick lintel, connection to supporting structure, and relationship with adjacent construction. Show sizes, elevations, sections and details of concealed lintel system, and locations of each.

e. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

D. Samples for Initial Selection: For the following:

1. Provide Samples of masonry units showing the full range of colors and textures available for each different exposed masonry unit required.

a. Face brick, in the form of straps of five or more bricks. Submit 10 straps.

2. Weep holes/vents.

3. Colored mortar Samples showing the full range of colors available.

E. Samples for Verification: For the following:

1. Full-size units for each different exposed masonry unit required, showing the full range of exposed colors, textures, and dimensions to be expected in the completed construction. Include the following:

a. Exposed concrete masonry units.

b. Face brick, in the form of straps of five or more bricks. Submit 10 straps.

2. Colored mortar: Samples for each color required, showing the full range of colors expected in the finished construction. Make samples using the same sand and mortar ingredients to be used on Project. Label Samples to indicate types and amounts of pigments used.

3. Stone trim samples not less than 12 inches in length, showing the full range of colors and textures expected in the finished construction.

4. Weep holes/vents in color to match mortar color.

5. Accessories embedded in the masonry.

F. List of Materials Used in Constructing Mockup: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents, unless such deviations are specifically brought to the attention of the Architect and approved in writing.

G. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

H. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:

1. Masonry units.

a. Include material test reports substantiating compliance with requirements.

b. For bricks, include size-variation data verifying that actual range of sizes falls within specified tolerances.

c. For exposed brick, include material test report for efflorescence according to ASTM C 67.

d. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. For cavity insulation, certifying compatibility of cavity insulation and accessory materials with Project materials that connect to or that come in contact with the insulation; signed by product manufacturer.

3. Certify compliance of wall assembly as a system including cavity insulation and accessory materials included as part of the Work of this Section with fire performance requirements of NFPA 285.

4. Cementitious materials. Include brand, type, and name of manufacturer.

5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.

6. Grout mixes. Include description of type and proportions of ingredients.

7. Reinforcing bars.

8. Joint reinforcement.

9. Anchors, ties, and metal accessories.

I. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.

2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

J. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

K. Cold-Weather Procedures: Submit detailed description of methods, materials, and equipment to be used to comply with cold-weather requirements.

1.5 QUALITY ASSURANCE

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

C. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Payment for these services will be made by Owner. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.

1. Clay Masonry Unit Test: For each clay masonry unit indicated, per ASTM C 67.
2. Concrete Masonry Unit Test: For each concrete masonry unit indicated, per ASTM C 140.
3. Prism Test: For each type of wall construction indicated, per ASTM C 1314.
4. Grout Test: For compressive strength per ASTM C 1019.

D. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.

E. Mockups: Before installing unit masonry, build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Construct Mock-up braced on a pallet suitable for transport on site to each building in this scope.
2. Build mockups for the masonry wall assemblies as indicated by the drawings by full thickness, including face and backup wythes and accessories. Include a sealant-filled joint at least 16 inches long.
    a. Exterior wall:
        1) Include concrete unit masonry backup construction, fluid-applied and self-adhering sheet air barriers, cavity insulation, cavity drainage material, veneer anchors, flashing, veneer and weep holes.
        2) Include brick veneer; CMU, and roof transition as shown and detailed.
        3) Include metal fascia, and supporting construction.
3. Clean exposed faces of mockups with masonry cleaner as indicated.
4. Notify Architect seven days in advance of dates and times when mockup will be constructed.
5. Protect accepted mockups from the elements with weather-resistant membrane.

6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

7. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.

   a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.

   b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups, unless such deviations are specifically approved by Architect in writing.

8. Demolish and remove mockups when directed.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

2. Where one wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by coverings spread on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602 and as follows:

1. Do not use frozen materials or materials coated or mixed with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions.
2. Heat brick, block, stone, sand, water, and mortar materials, and items to be included in masonry work including but not limited to flashing, weep vents, ties, joint reinforcement, reinforcing steel and embedded anchors sufficiently to maintain the masonry components and mortar above 50 degrees F when used. Provide enclosure and auxiliary heat to maintain masonry work in progress, completed masonry work, materials, and surrounding air temperature at a temperature of 50 degrees F or higher during the masonry work, for not less than 48 hours after completion of the masonry work, and as necessary to keep the work from freezing. Refer to Division 1 Section “Temporary Facilities and Controls” for temporary heating.
3. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602 and as follows:

1. Protect unit masonry work when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade and wind breaks and use cooled materials as required.
2. When ambient temperature exceeds 100 deg F, or 90 deg F with a wind velocity greater than 8 mph, do not spread mortar beds more than 48 inches ahead of masonry. Set masonry units within one minute of spreading mortar.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not uses defective units where irregularities will be exposed to view in the completed Work or will impair the quality of completed masonry.

2.2 CONCRETE MASONRY UNITS (CMUS)

A. General: Provide shapes indicated and as follows:

1. Provide special shapes for lintels, corners, jambs, sash, control joints, headers, bonding, and other special conditions.

2. Provide square-edged units for outside corners, unless indicated as bullnose.

B. Concrete Masonry Units: ASTM C 90 and as follows:

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3000 psi.

2. Weight Classification: Light weight.

3. Size (Width): Manufactured to the following dimensions:

   a. 2 inches nominal; 1-5/8 inches actual.

   b. 4 inches nominal; 3-5/8 inches actual.

   c. 6 inches nominal; 5-5/8 inches actual.

   d. 8 inches nominal; 7-5/8 inches actual.

   e. 10 inches nominal; 9-5/8 inches actual.

   f. 12 inches nominal; 11-5/8 inches actual.

4. Exposed Faces: Manufacturer's standard color and texture, unless otherwise indicated.

5. Recycled Content: Minimum 5 percent post-consumer recycled content, or minimum 20 percent pre-consumer recycled content at contractor’s option.

6. Block Type: Provide standard units as required for vertical reinforcing.

7. Size: As indicated on the drawings.

8. Filler: Factory installed incombustible fibrous material with laminated metal septa on one side.

9. Install as indicated on the drawings and per manufacturer’s recommended installation instructions.

2.3 BRICK

A. General: Provide shapes indicated and as follows for each form of brick required:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.

2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.

3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.

4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Face Brick: ASTM C 216, Grade SW, Type FBX, and as follows:

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 5000 psi.
2. Initial Rate of Absorption: Less than 20 g/30 sq. in. per minute when tested per ASTM C 67.
3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
4. Surface Coloring: Brick with surface coloring, other than flashed or sand-finished brick, shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet.
5. Size: Manufactured to the following actual dimensions:
    a. Modular: 3-1/2 to 3-5/8 inches wide by 2-1/4 inches high by 7-1/2 to 7-5/8 inches long.
6. Application: Use where brick is exposed, unless otherwise indicated.
7. Color and Texture: Blend of light ironspot brick in colors and with variation to match Architect's samples, and as follows:
    a. Basis of Design Face Brick (used on existing building): Sioux City Brick; "Special Blend 80% Coppertone / 20% Grand Canyon" factory-blended smooth brick produced at the Sergeant Bluff, Iowa plant and as distributed by Mack Brick Company, Enfield, CT. Subject to compliance with requirements, provide the named brick or one of the following, subject to approval of samples by Architect. Basis of Approval for an alternate will be its ability to match existing building brick exactly:
        1) Alternate 1 Face Brick: Belden Brick; "Modular 470 – 479 Medium A" factory-blended smooth brick manufactured at Sugar Creek Plant 4.
        2) Alternate 2 Face Brick: Glen-Gery Brick; "Engobe Series" SIS-62 50%, SIS-392 40%, SIS-21-22-10 10% factory blended smooth brick manufactured at Glen-Gery Hanley Plant.

2.4 MORTAR AND GROUT MATERIALS

A. Provide preblended mixes only for mortars and grouts.
1. For use with brick: Type "N"
2. For use with CMU: Type "S"

B. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
1. Fly Ash: Comply with ASTM C593.
    a. Recycled Content: Minimum 5 percent post-consumer recycled content, or minimum 20 percent pre-consumer recycled content at contractor's option.
2. Slag: Comply with ASTM C989; Grade 100.
    a. Recycled Content: Minimum 5 percent post-consumer recycled content, or minimum 20 percent pre-consumer recycled content at contractor's option

C. Hydrated Lime: ASTM C 207, Type S.

D. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207.

E. Aggregate for Mortar: ASTM C 144; except for joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.

1. White-Mortar Aggregates: Natural white sand or ground white stone.

2. Colored-Mortar Aggregates: Natural-colored sand or ground marble, granite, or other sound stone; of color necessary to produce required mortar color.

a. Multiple aggregate colors may be required.

F. Aggregate for Grout: ASTM C 404.

G. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortar.

1. Color: As selected by Architect from pigment manufacturer's full range of available colors including custom-mixed. Multiple mortar colors may be required.

H. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C, and recommended by the manufacturer for use in masonry mortar of composition indicated.

I. Water: Potable.

J. Products: Subject to compliance with requirements, provide one of the following:

1. Colored Portland Cement-Lime Mix:

a. Eaglebond; Blue Circle Cement.

b. Color Mortar Blend; Glen-Gery Corporation.

c. Rainbow Mortamix Custom Color Cement/Lime; Holnam, Inc.

d. Centurion Colorbond PL; Lafarge Corporation.

e. Lehigh Custom Color Portland/Lime; Lehigh Portland Cement Co.

f. Riverton Portland Cement Lime Custom Color; Riverton Corporation (The).

2. Mortar Pigments:

a. True Tone Mortar Colors; Davis Colors.

b. Centurion Pigments; Lafarge Corporation.

c. SGS Mortar Colors; Solomon Grind-Chem Services, Inc.

3. Water-Repellent Admixture:

a. Mortar Tite; Addiment Inc.

b. Dry-Block Mortar Admixture; W. R. Grace & Co., Construction Products Division.

c. Rheopel; Master Builders.

2.5 REINFORCING STEEL

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M; ASTM A 616/A 616M, including Supplement 1; or ASTM A 617/A 617M, Grade 60.

2.6 MASONRY JOINT REINFORCEMENT

A. General: ASTM A 951 and as follows:

1. Hot-dip galvanized, carbon-steel wire for both interior and exterior walls.
2. Wire Size for Side Rods: W2.8 or 0.188-inch diameter.
3. Wire Size for Cross Rods: W1.7 or 0.148-inch diameter.
4. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units where indicated.
5. Recycled Content: Minimum 10 percent post-consumer recycled content, or minimum 25 percent pre-consumer recycled content at contractor's option.

B. For single-wythe masonry, provide either ladder or truss type with single pair of side rods and cross rods spaced not more than 16 inches o.c.

C. For multiwythe masonry, provide types as follows:

1. Adjustable (2-piece) type with single pair of side rods and cross ties spaced not more than 16 inches o.c. and with separate adjustable veneer ties engaging the cross ties. Cross ties are either U-shaped with eyes or rectangular. Space side rods for embedment within each face shell of backup wythe and size adjustable ties to extend at least halfway through outer wythe but with at least 5/8-inch cover on outside face.

D. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.188-inch- diameter, hot-dip galvanized, carbon-steel continuous wire.

2.7 TIES AND ANCHORS, GENERAL

A. General: Provide ties and anchors, specified in subsequent articles, made from materials that comply with this Article, unless otherwise indicated.

B. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 641/A 641M, Class 1 coating.

C. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.

D. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.

E. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 zinc coating.

F. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.

G. Stainless-Steel Sheet: ASTM A 666, Type 304.

H. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

I. Stainless-Steel Bars: ASTM A 276 or ASTM a 666, Type 304.

2.8 ADJUSTABLE ANCHORS FOR CONNECTING TO CMU AND EXISTING CONCRETE

A. General: Provide two-piece assemblies that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.

1. Anchor Section: Dual-diameter stainless steel barrel with polymer coated screw for installation into 3/16 x 2 inch deep hole predrilled into concrete or cmu backup construction, factory installed EPDM washer to seal penetration through cavity insulation and air/vapor barrier, and factory installed wings to receive pintles/hooks of tie section.

2. Tie Section: Rectangular-shaped wire tie with two hooks to fit into receiver of anchor section, sized to extend within 1 inch of masonry face, made from 3/16-inch- diameter, hot-dip galvanized steel wire.

2.9 ADJUSTABLE MASONRY-VENEER ANCHORS

A. General: Provide two-piece assemblies that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:

1. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.

2. Anchor Sections: One of the following:

a. Anchor Section: Sheet metal plate, 1-1/4 inches (32 mm) wide by 6 inches (150 mm) long, with screw holes top and bottom, pronged and rib stiffened legs inset from top and bottom ends of plate and of length to match thickness of insulation or sheathing and contact studs, and raised rib-stiffened strap 5/8 inch (16 mm) wide by 6 inches (150 mm) long stamped into center to provide a slot between strap and plate for inserting wire tie. Provide anchor manufacturer's self-adhering polyethylene foam tape manufactured to fit behind anchor plates in continuous application.

1) Fabricate sheet metal anchor sections and other sheet metal parts from 0.0966-inch- thick, steel sheet, galvanized after fabrication.

b. Anchor Section: Zinc-alloy barrel section with flanged head with eye and corrosion-resistant, self-drilling screw. Eye designed to receive wire tie and to serve as head for drilling fastener into framing. Barrel length to suit sheathing thickness, allowing screw to seat directly against framing with flanged head covering hole in sheathing.

3. Wire Tie Section: Triangular- shaped wire tie sized to extend at least halfway through veneer but with at least 5/8-inch cover on outside face.

a. Fabricate wire tie sections from 0.1875-inch- diameter, hot-dip galvanized steel wire.

B. Seismic Masonry-Veneer Anchors: Units consisting of a metal anchor section and a connector section designed to engage a continuous wire embedded in the veneer mortar joint, complying with the following requirements:

1. Anchor Section: One of the following:

a. Anchor Section: Gasketed sheet metal plate with screw holes top and bottom; top and bottom ends bent to form pronged legs to bridge insulation or sheathing and

contact studs; and raised rib-stiffened strap stamped into center to provide a slot between strap and plate for connection of wire tie.

1) Plate 1-1/4 inches wide by 6 inches long with strap 5/8 inch wide by 6 inches long; slot clearance formed between face of plate and back of strap shall not exceed diameter of wire tie by more then 1/32 inch.

2) Provide anchor manufacturer's standard, self-adhering, modified bituminous gaskets manufactured to fit behind anchor plate and to prevent moisture from penetrating sheathing at pronged legs and screw holes.

b. Anchor Section: Sheet metal plate, 1-1/4 inches (32 mm) wide by 6 inches (150 mm) long, with screw holes top and bottom, pronged and rib stiffened legs inset from top and bottom ends of plate and of length to match thickness of insulation or sheathing and contact studs, and raised rib-stiffened strap 5/8 inch (16 mm) wide by 6 inches (150 mm) long stamped into center to provide a slot between strap and plate for inserting wire tie. Provide anchor manufacturer's self-adhering polyethylene foam tape manufactured to fit behind anchor plates in continuous application.

c. Anchor Section: Zinc-alloy barrel section with flanged head with eye and corrosion-resistant, self-drilling screw. Eye designed to receive wire tie and to serve as head for drilling fastener into framing. Barrel length to suit sheathing thickness, allowing screw to seat directly against framing with flanged head covering hole in sheathing.

d. Fabricate sheet metal anchor sections and other sheet metal parts from 0.0966-inch- thick, steel sheet, galvanized after fabrication.

2. Connector Section: One of the following:

a. Connector Section: Triangular wire tie and rigid PVC extrusion with snap-in grooves for inserting continuous wire. Size wire tie to extend at least halfway through veneer but with at least 5/8-inch cover on outside face.

b. Connector Section: Rectangular wire tie with overlapping ends, swaged and pitched to interlock with continuous wire. Size wire tie to extend at least halfway through veneer but with at least 5/8 inch (16 mm) cover on outside face.

c. Fabricate wire connector sections from 0.1875-inch- diameter, hot-dip galvanized steel wire.

3. Wire Tie Section: Triangular- shaped wire tie sized to extend at least halfway through veneer but with at least 5/8-inch cover on outside face and with welded metal clip to secure continuous wire in joint.

4. Continuous Wire: 0.1875-inch- diameter, hot-dip galvanized steel wire.

C. Polymer-Coated, Steel Tapping Screws for Concrete Masonry: Self-tapping screws with specially designed threads for tapping and wedging into masonry, with hex washer head and neoprene washer, 3/16-inch diameter by 1-1/2-inch length, and with organic polymer coating with salt-spray resistance to red rust of more than 800 hours per ASTM B 117.

D. Sealing Tape: 40 mil thick multi ply, polyethylene / polymer modified asphalt, self sealing; adhesive backed.

E. Products: Subject to compliance with requirements, provide one of the following:

1. Screw-Attached, Masonry-Veneer Anchors:
   a. D/A 210 with D/A 700-708; Dur-O-Wal, Inc.
   b. 315-D with 316; Heckman Building Products, Inc.
   c. DW-10; Hohmann & Barnard, Inc.
   d. DW-10HS; Hohmann & Barnard, Inc.
   e. 1004, Type III; Masonry Reinforcing Corporation of America.
2. Seismic Masonry-Veneer Anchors:
   a. D/A 213S; Dur-O-Wal, Inc.
   b. DW-10-X-Seismiclip; Hohmann & Barnard, Inc.
   c. X-Seal S.I.S., Holmann & Barnard, Inc.
   d. RJ-711 with Wire-Bond clip; Masonry Reinforcing Corporation of America.
3. Sealing Tape
   a. Textroseal; Hohmann & Barnard, Inc.

2.10 MISCELLANEOUS ANCHORS

A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron inserts of type and size indicated.

B. Anchor Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153, Class C; of diameter and length indicated and in the following configurations:

1. Headed bolts.
2. Nonheaded bolts, bent in manner indicated.

C. Postinstalled Anchors: Anchors as described below, with capability to sustain, without failure, load imposed within factors of safety indicated, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Type: Chemical anchors.
2. Type: Expansion anchors.
3. Type: Undercut anchors.
4. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 for bolts and nuts; ASTM A 666 or ASTM A 276, Type 304 or 316, for anchors.
5. For Postinstalled Anchors in Concrete: Capability to sustain, without failure, a load equal to four times the loads imposed.
6. For Postinstalled Anchors in Grouted Masonry Units: Capability to sustain, without failure, a load equal to four times the loads imposed.

2.11 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Fabricate from the following metal complying with requirements specified in Division 07 Section "Sheet Metal Flashing and Trim" and as follows:

1. Zinc-Tin Alloy-Coated Copper: ASTM B 370, Temper H00 and H01, cold-rolled copper sheet of the following weights: 10-oz / sq ft weight (0.0135 inch thickness) for fully concealed flashing; 16-oz / sq ft weight (0.0216 inch thickness) elsewhere, and coated both sides with Zinc-Tin alloy, alloy composed of 50% Zinc and 50% Tin, hot-dip applied evenly to both faces of copper sheet to a thickness of 0.5 mils on each face of sheet.
2. Fabricate through-wall metal flashing embedded in masonry from zinc-tin alloy coated copper and with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.
3. Fabricate metal expansion-joint strips from zinc-tin alloy coated copper, formed to shape indicated.
4. Fabricate metal drip edges from zinc-tin alloy coated copper. Extend into wall as indicated by Drawings, but in no case less than 3 inches, and 1/2 inch out from wall, with a hemmed outer edge bent down 30 degrees.
5. Fabricate metal flashing terminations from zinc-tin alloy coated copper. Extend into wall as indicated by Drawings, but in no case less than 3 inches, and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and then down into joint 3/8 inch to form a stop for retaining sealant backer rod

B. Flexible Flashing: Where indicated, use the following for flashing not exposed to the exterior:

1. Copper-Laminated Flashing: Manufacturer's standard asphalt-free laminated flashing fabricated from 7 oz./sq. ft. (2-kg/sq. m) sheet copper laminated with non-asphaltic adhesive between 2 layers of polymer cloth, and compatible with air and vapor barriers included in the wall assembly. Use only where flashing is fully concealed in masonry.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) Hohmann & Barnard, Inc.; H & B Copper-Fabric NA Copper Fabric Flashing.
      2) Wire-Bond; Copper Seal copper fabric flashing.
      3) York Manufacturing, Inc.; Multi-Flash 500.

C. Solder and Sealants for Sheet Metal Flashings:

1. Solder for Zinc-Tin Alloy-Coated Copper: ASTM B 32, Grade Sb5: 94 percent tin, 4.5-5.5 percent antimony and lead content not to exceed 0.05 percent.

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by the flashing manufacturer for bonding flashing sheets to each other and to substrates.

E. At exposed column faces on the exterior face of the inner wythe of the exterior walls apply self-adhering sheet air barrier membrane full height of column and as indicated. Extend 6” minimum on masonry on either side of column. Flash out over top of foundation wall. Conform to manufacturer’s installation instructions.

2.12 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.

B. Preformed Control-Joint Gaskets: Material as indicated below, designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

1. Styrene-Butadiene-Rubber Compound: ASTM D 2000, Designation M2AA-805.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.187-inch steel wire, hot-dip galvanized after fabrication.

1. Provide units with either two loops or four loops as needed for number of bars indicated.

2. Recycled Content: Minimum 5 percent post-consumer recycled content, or minimum 20 percent pre-consumer recycled content at contractor's option.

3. Products: Subject to compliance with requirements, provide one of the following:

a. Reinforcing Bar Positioners:

1) D/A 811; Dur-O-Wal, Inc.

2) D/A 816; Dur-O-Wal, Inc.

3) No. 376 Rebar Positioner; Heckman Building Products, Inc.

4) #RB Rebar Positioner; Hohmann & Barnard, Inc.

5) #RB-Twin Rebar Positioner; Hohmann & Barnard, Inc.

6) Double O-Ring Rebar Positioner; Masonry Reinforcing Corporation of America.

7) O-Ring Rebar Positioner; Masonry Reinforcing Corporation of America.

E. Weep Vent: Honeycomb-type vent fabricated from UV-resistant polypropylene copolymer, 3/8 by 3-3/8 by 2-1/2 inches high designed to fill head joint with outside face held back 1/8 inch from exterior face of masonry, in color selected by Architect from manufacturer's full range of standard colors to match mortar.

1. Products: Subject to compliance with requirements, provide the following:

a. Plastic Weep Vent:

1) QV Quadro-Vent; Hohmann and Barnard.

2) Mortar Maze; Advanced Building Products.

3) No. 85 Cell Vent; Heckman Building Products.

F. Cavity Drainage Material for Brick Veneer Cavity Walls: Free-draining mesh mat in thickness to fit entire depth of cavity and installed in cavity; made from polyethylene strands.

1. Products: Subject to compliance with requirements, provide the following:

a. Cavity Drainage Material for Brick Veneer Cavity Walls:

1) Mortar Net; Mortar Net USA, Ltd.

2) CavClear Masonry Mat; Archovations, Inc.

3) Waterway Rainscreen Drainage Mats; Stuc-o-Flex International, Inc.

2.13 CAVITY-WALL INSULATION

A. Extruded-Polystyrene Board Insulation: Rigid, cellular, polystyrene thermal insulation with closed cells and integral high-density skin; formed by the expansion of polystyrene base resin in an extrusion process to comply with ASTM C 578, Type IV, with an R-value of not less than 5 per inch as determined by ASTM C 518, and flame spread rating not more than 25 and smoke developed not more than 450 as determined by testing in accordance with ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:

   a. DiversiFoam Products.

   b. Dow Chemical Company.

   c. Owens Corning.

   d. Pactiv Building Products Division.

B. Adhesive: Type recommended by insulation board manufacturer for application indicated.

2.14 MASONRY CLEANERS

A. Job-Mixed Detergent Solution: Solution of 1/2-cup dry measure tetrasodium polyphosphate and 1/2-cup dry measure laundry detergent dissolved in 1 gal. of water.

B. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Cleaners for Red and Light-Colored Brick Not Subject to Metallic Staining with Mortar Not Subject to Bleaching:

      1) 202 New Masonry Detergent; Diedrich Technologies, Inc.

      2) Sure Klean No. 600 Detergent; ProSoCo, Inc.

2.15 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in the form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification.

1. Limit cementitious materials in mortar to portland cement and lime.

2. For masonry below grade, in contact with earth, and where indicated, use Type N.

3. For reinforced concrete unit masonry and where indicated, use Type S.

4. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls use Type N.

5. For interior walls, Type S.

D. Pigmented Mortar: Select and proportion pigments with other ingredients to produce color required. Limit pigments to the following percentages of cement content by weight:

1. For mineral-oxide pigments and portland cement-lime mortar, not more than 10 percent.

2. For carbon-black pigment and portland cement-lime mortar, not more than 2 percent.

E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates combined with selected cementitious materials.

1. Mix to match Architect's sample.

F. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 5 of ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.

2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143.

2.16 SOURCE QUALITY CONTROL

A. Engage a qualified independent testing agency to perform source quality-control testing indicated below:

1. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.

B. Brick Test: For each type of unit furnished, per ASTM C 67.

C. Concrete Masonry Unit Test: For each type of unit furnished, per ASTM C 140.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance.

2. Verify that foundations are within tolerances specified.

3. Verify that reinforcing dowels are properly placed.

4. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Before installation, examine rough-in and built-in construction to verify actual locations of piping connections, conduits, boxes, steel and the like.

3.2 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to the full thickness shown. Build single-wythe walls to the actual widths of masonry units, using units of widths indicated.

B. Begin construction of masonry at the base of the building and work up; do not build building structure supported masonry walls at any level until masonry at lower floors is complete.

C. Build chases and recesses to accommodate items specified in this Section and in other Sections.

D. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to the opening.

E. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide a continuous pattern and to fit adjoining construction. Where possible, use full-size units without cutting. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

F. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

G. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

1. Tooth-in new masonry into existing masonry where infilling openings or patching holes.

H. Wetting of Brick: Wet brick before laying if the initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at the time of laying.

I. Accessories: Accessories to be installed in masonry construction shall be installed according to accessory manufacturer's written instructions and recommendations as coordinated with requirements of this Section.

3.3 CONSTRUCTION TOLERANCES

A. Comply with tolerances in ACI 530.1/ASCE 6/TMS 602 and the following:

1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/4 inch in 20 feet, nor 1/2 inch maximum.

2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, nor 1/2 inch maximum.

3. For conspicuous horizontal lines, such as exposed lintels, sills, parapets, and reveals, do not vary from level by more than 1/4 inch in 20 feet, nor 1/2 inch maximum.

4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.

5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.

B. Masonry to receive ceramic tile finish: In addition to the above specified tolerances, the following apply to masonry surfaces to which ceramic tile will be applied:

1. Variation from plane surface: Not to exceed 1/8 inch in 10 feet, and 1/16 inch in 1 foot.

2. Lippage: Variation in surface planes between adjacent masonry units shall be not more than 1/32 inch between any two adjacent masonry units taken in any direction at any location in the wall.

a. Where masonry does not meet the specified tolerances for variations from plane surface or lippage, take corrective measures through grinding, parging or other industry recognized means and methods to bring masonry into compliance.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Lay exposed masonry in the following bond pattern; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

1. One-half running bond with vertical joint in each course centered on units in courses above and below.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 2 inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: In each course, rack back one-half-unit length for one-half running bond or one-third-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry, wet clay masonry units lightly if required, and remove loose masonry units and mortar before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified under this and other Sections of the Specifications. Fill in solidly with masonry around built-in items.

F. Fill space between hollow-metal frames and masonry solidly with mortar, unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath in the joint below and rod mortar or grout into core.

H. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.

2. At fire-rated partitions, install firestopping in joint between top of partition and underside of structure above to comply with Division 7 Section "Firestopping."

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow masonry units as follows:

1. With full mortar coverage on horizontal and vertical face shells.
2. Bed webs in mortar in starting course on footings and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be filled with grout.
3. For starting course on footings where cells are not grouted, spread out full mortar bed, including areas under cells.

B. Lay clay brick with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

1. At cavity walls, bevel beds away from cavity, to minimize mortar protrusions into cavity. As work progresses, trowel mortar fins protruding into cavity flat against the cavity face of the brick.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than the joint thickness, unless otherwise indicated.

3.6 BONDING OF MULTIWYTHE MASONRY

A. Use masonry joint reinforcement installed in horizontal mortar joints to bond wythes together.

B. Corners: Provide interlocking masonry unit bond in each wythe and course at corners, unless otherwise indicated.

1. Provide continuity with masonry joint reinforcement at corners by using prefabricated "L" units as well as masonry bonding.

C. Intersecting and Abutting Walls: Unless vertical expansion or control joints are shown at juncture, bond walls together as follows:

1. Provide continuity with masonry joint reinforcement by using prefabricated "T" units.

D. Install anchors within 12” above and below all CMU bands in brick masonry walls.

3.7 CAVITIES

A. Keep cavities clean of mortar droppings and other materials during construction.

1. Use wood strips temporarily placed in cavity to collect mortar droppings. As work progresses, remove strips, clean off mortar droppings, and replace in cavity.

B. Install air and vapor barrier on cavity face of backup construction in compliance with requirements of Division 7 Section “Fluid-Applied Membrane Air Barriers.”

C. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

1. Tape joints with tape used for taping joints between panels of rigid insulation.

D. Install cavity drainage material over base flashings to the height of the base flashing or one full block course, whichever is higher. Use multiple layers, if necessary, to fill the full depth of the cavity space.

3.8 MASONRY JOINT REINFORCEMENT

A. General: Provide continuous masonry joint reinforcement as indicated. Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement immediately above and below CMU bands in brick masonry walls.
4. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
    a. Reinforcement above is in addition to continuous reinforcement.

B. Cut or interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at corners and wall intersections by using prefabricated "L" and "T" sections. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.9 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to concrete and masonry backup with masonry-veneer anchors to comply with the following requirements:

1. Coordinate installation of brick veneer and architectural precast concrete units.
2. Install sealing tape at stud locations to receive veneer anchors; install tape vertically, continuous full stud length.
3. Fasten each anchor section to concrete and masonry backup with two metal fasteners of type indicated.
4. Fasten anchors to concrete and masonry backup with metal fasteners of type indicated.
5. Embed tie sections in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.
6. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
7. Space anchors as indicated, but not more than 16 inches o.c. vertically and 16 inches o.c. horizontally, with not less than 1 anchor for each 2 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around the perimeter.

3.10 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joints in unit masonry where indicated. Build-in related items as masonry progresses. Do not form a continuous span through movement joints unless provisions are made to prevent in-plane restraint of wall or partition movement.

B. Form control joints in concrete masonry as follows:

C. Form expansion joints in brick made from clay or shale as follows:

1. Form open joint of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Division 7 Section "Joint Sealants." Keep joint free and clear of mortar.

3.11 FLASHING, WEEP HOLES, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Unless otherwise indicated, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

C. Install flashing as follows:

1. At multiwythe masonry walls, including cavity walls, extend flashing from exterior face of outer wythe of masonry, through outer wythe, turned up a minimum of 8 inches, and through inner wythe to within 1/2 inch of the interior face of the wall in exposed masonry. Where interior surface of inner wythe is concealed by furring, carry flashing completely through inner wythe and turn flashing up approximately 2 inches, unless otherwise indicated.

2. At masonry-veneer walls, extend flashing from exterior face of veneer, through veneer, up face of sheathing at least 8 inches, and behind air-infiltration barrier or building paper.

3. At lintels and shelf angles, extend flashing a minimum of 4 inches into masonry at each end. At heads and sills, extend flashing 4 inches at ends and turn flashing up not less than 2 inches to form a pan.

4. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Division 7 Section "Joint Sealants" for application indicated.

5. Extend sheet metal flashing 1/2 inch beyond face of masonry at exterior and turn flashing down to form a drip.

6. Where flexible flashing is installed, install metal drip edges beneath flashing at exterior face of wall. Stop flashing 1/2 inch back from outside face of wall and adhere flashing to top of metal drip edge.

7. Where flexible flashing is installed, install metal flashing termination beneath flashing at exterior face of wall. Stop flashing 1/2 inch back from outside face of wall and adhere flashing to top of metal flashing termination.

8. Where flexible flashing is installed, cut flashing off flush with face of wall after masonry wall construction is completed.

D. Install weeps in the head joints in exterior wythes of the first course of masonry immediately above embedded flashing and as follows:

1. Use plastic weep vents to form weeps.

2. Space weep vents 16 inches o.c. in brick and 24 inches in CMU, unless otherwise noted.

3. Place cavity drainage material immediately above flashing in cavities.

E. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.12 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores to support reinforced masonry elements during construction.

1. Construct formwork to conform to shape, line, and dimensions shown. Make it sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements of ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure. Use low lift grouting procedures for all walls only. Grout to be placed in masonry cells a maximum of 5’0” in height.

1. Comply with requirements of ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.13 FIELD QUALITY CONTROL

A. Owner will engage a qualified independent testing agency to perform field quality-control testing indicated below.

1. Payment for these services will be made by Owner.

2. Retesting of materials failing to meet specified requirements shall be done at Contractor's expense.

B. Testing frequency below is required by the 1997 Uniform Building Code when full allowable stresses are used in the design of masonry and by MSJC Specification when prism or grout testing is required.

C. Testing Frequency: Tests and Evaluations listed in this Article will be performed during construction for each 5000 sq. ft. of wall area or portion thereof and as required by The Statement of Special Inspections.

D. Testing requirements for mortar and grout may be deleted if prism testing is retained.

E. Mortar properties will be tested per ASTM C 780.

F. Grout will be sampled and tested for compressive strength per ASTM C 1019.

G. Brick Tests: For each type and grade of brick indicated, units will be tested according to ASTM C 67.

H. Concrete Masonry Unit Tests: For each type of concrete masonry unit indicated, units will be tested according to ASTM C 140.

I. Prism-Test Method: For each type of wall construction indicated, masonry prisms will be tested per ASTM C 1314, and as follows:

1. Prepare 1 set of prisms for testing at 7 days and 1 set for testing at 28 days.

J. Field Quality-Control Water Leakage Test: Test entire masonry assembly according to AAMA 501.2.

1. Notify Architect seven days in advance of dates and times when testing will be done.
2. Perform test at three locations as directed by Architect.
3. Report test results in writing to Architect and Owner.

3.14 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent, polyethylene film, or waterproof masking tape.
4. Saturate wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing the surfaces thoroughly with clear water.
5. Flush area to be cleaned and areas below area to be cleaned with water from the top down. Saturate before application of cleaning solution, and keep wet until after the final rinse.
6. Apply cleaning solution. Do not allow cleaning solution to dry on masonry.
    a. For proprietary compounds follow manufacturer’s instructions.
    b. Do not use unbuffered muriatic acid.
7. Rinse cleaned areas and areas below thoroughly with clear water to completely remove cleaning solution and dissolved matter from masonry.
8. Cleaning Requirements by Masonry Type:
    a. Masonry Units as Follows:
        1) Clean brick by the bucket-and-brush hand-cleaning method described in BIA Technical Notes No. 20, using job-mixed detergent solution.
        2) Do not use pressure washing for cleaning.
        3) Do not use abrasive blasting for cleaning.

9. Concrete Masonry: Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

10. Stone: Clean stone trim to comply with stone supplier's written instructions as coordinated with instructions furnished with stone cleaner and sealer.

3.15 SITE ENVIRONMENTAL PROCEDURES

A. Waste Management: As specified in Division 1 and as follows:

1. Mixing Equipment: Minimize water used to wash equipment.

2. Broken, waste masonry units may be used as non-structural fill if approved by Architect/Engineer.

3. Cured, crushed waste mortar may be used as non-structural fill if approved by Architect/Engineer.

4. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product.

5. Excess Masonry Waste: At completion of unit masonry work, remove excess masonry waste, and legally dispose of off Owner's property

END OF SECTION 04 20 00

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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. Hot dip galvanizing using the dry-kettle process.
2. Factory-applied primer, color, and UV coats over galvanized items indicated to receive color coats.

1.3 DEFINITIONS

A. Galvanizing: Coating steel with zinc to provide a barrier and cathodic protection from corrosion.

B. Duplex systems: Galvanized steel that has been coated with an additional corrosion-inhibiting product, typically liquid or powder paint; the two separate coating systems to provide enhanced corrosion protection.

C. Passivation: Changing chemically active metal surfaces to a much less reactive state.

D. Phosphating: Forming an adherent phosphate coating on a metal by immersion in a suitable aqueous phosphate solution, commonly used to promote better adhesion of paint to galvanized steel.

1.4 REFERENCE STANDARDS:

A. American Hot Dip Galvanizers Association, Inc. (AHDGA): Publication Entitled, “Inspection Manual for Hot Dip Galvanized Products”.

B. American Society for Testing and Materials (ASTM):

1. A 123/A 123M – 02 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
2. A 153 – 05 Zinc Coating (Hot Dip) on Iron and Steel Hardware.
3. A 780 Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
4. D 6386 – 99 Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting.

C. Society for Specialty and Protective Coatings (SSPC)

1. SSPC-PS Guide 12.00 Guide to Zinc-Rich Coating Systems
2. SSPC-QP3 – Certification Standard for Shop Application of Complex Protective Coating Systems

1.5 QUALITY ASSURANCE

A. Galvanizer’s Qualifications: Engage the services of a qualified galvanizer who has demonstrated a minimum of ten years’ experience in the successful application of galvanized

coatings utilizing the dry-kettle process and maintains a dedicated facility for the application of primer and finish coats specified in this Section conforming to SSPC-QP3 – Certification Standard for Shop Application of Complex Protective Coating Systems.

B. Pre-Construction Conference: Contractor shall schedule a meeting to be attended by Contractor, Architect, fabricator, and galvanizer. Agenda shall include the following: Project schedule, scope of services, coordination between fabricator and galvanizer, finish of surfaces, application of coatings, color selections, submittals, and approvals.

C. Environmental Compliance: Coatings shall be certified OTC/VOC compliant and conform to EPA standards and local regulations.

1.6 SUBMITTALS

A. Product Literature for Factory-Applied Metal Coatings: Submit galvanizer's product literature for coatings specified in this Section including test data.

B. Verification Samples for Factory-Applied Metal Coatings: Submit two 3 inch by 6 inch samples of factory-applied coatings and colors proposed for use for approval prior to coating application.

C. Maintenance Data: Submit 2 copies, covering the installed products, to Architect.

D. Certification:

1. Shop Drawings submitted to the Architect shall have been marked as "reviewed to the satisfaction of the galvanizer," for suitability of materials, arrangements of components, continuity of drains, and resolution of constraints that might adversely affect galvanizing and any subsequent coatings.

2. Certificate of Compliance for Items Coated by Galvanizer: Submit Certification listing articles and confirming that tests of galvanized coatings made according to ASTM A123 are consistent with specified coverage.

3. Certificate of Compliance of Item Identification by Galvanizer: The galvanizer shall mark all lots of material with a clearly visible tag indicating the name of the galvanizer, the type and weight of the coating, and the applicable ASTM standards.

4. Certificate of Compliance for Shop Application: Galvanizer/applicator shall supply a certificate of compliance with SSPC-QP3 – Certification Standard for Shop Application of Complex Protective Coating Systems.

5. Certification from the American Galvanizers Association that Galvanizer has completed all course requirements and is a certified Master Galvanizer.

6. Certification of Coating Compatibility: Certification that factory-applied primers are completely compatible with factory-applied finish- and top- coats applied under requirements of this Section, and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

E. Galvanizer's written Quality Control/Quality Assurance manual for hot dip galvanizing and factory applied coating.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Packaging: Of type to prevent damage to galvanized, primed, and painted surfaces and distortion of steel materials and components.

B. Handling and Storage: Conform to ASTM A-123. Protect galvanized materials from damage to zinc coating, primer, and paint coating during handling. Space surfaces of galvanized, primed, and painted materials to permit free circulation of air during storage.

1.8 WARRANTY

A. Corrosion Protection: Galvanizer's standard warranty that materials shall be free from 10 percent or more visible rust for specified warranty period.

1. Warranty Period for Corrosion Protection: As specified in Division 1 Section "Warranties and Bonds."

B. Factory applied finish and clear coats: Applicator's warranty that materials factory-applied finish coat shall comply with the following for specified warranty period:

1. Fade: Loss of gloss not to exceed 20 units of gloss, measured in accordance with ASTM D 523-89 with 60 degrees geometry.

2. Color Shift: Not to exceed 12 DE CIE LAB units for whites and light colors (yellows, oranges, and reds are excluded) measured by ASTM D 2244.

3. Warranty Period for factory-applied color coat gloss and color: As specified in Division 1 Section "Warranties and Bonds."

PART 2 - PRODUCTS

2.1 GALVANIZING / FACTORY-APPLIED-PRIMER / FACTORY-APPLIED-PAINT

A. Basis of Design: The basis of design for hot dip galvanizing and factory application of primer and finish coats is Duncan Galvanizing, Everett, MA 02149, (800) 638-1011, www.duncangalvanizing.com as follows:

1. Hot-Dip Galvanizing: "Duragalv"

2. Factory-Applied Finish Coat: "Colorgalv 20" factory application process.

B. Subject to compliance with requirements, provide the named hot dip galvanizing and factory application of primer and finish coats, or comparable hot dip galvanizing and factory application of primer and finish coats by one of the following:

1. Hubbell Galvanizing, New York Mills, NY 13417, (800) 244-4258, www.hubbellgalvanizing.com.

2. V&S Taunton Galvanizing LLC, Taunton, MA 02780, 508-828-9499, taunton@hotdipgalvanizing.com.

3. V&S Lebanon Galvanizing LLC, Lebanon, PA 17038, 717-861-7777, lebanon@hotdipgalvanizing.com.

2.2 ZINC FOR GALVANIZING

A. ASTM B-6, as specified in ASTM A-123.

2.3 FACTORY APPLIED COATING MATERIALS, GENERAL

A. Provide factory applied primers, intermediate coat materials, UV resistant topcoat, and clear coat materials that are compatible with one another and with the substrates indicated under

conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Primer over Galvanized Steel: Provide factory-applied polyamide epoxy prime coat over hot-dipped galvanized steel.

1. Primer shall be certified OTC/VOC compliant at less than 2.8 lbs/gal. and conform to EPA and local requirements.

2. and meet or exceed the following performance criteria as stipulated by the coatings manufacturer:

a. Abrasion Resistance: ASTM D 4060 (CS17 Wheel, 1,000 grams load) 1kg load, 200 mg loss.

b. Adhesion: ASTM D 4541, 1050 psi.

c. Corrosion Weathering: ASTM D 5894, 13 cycles, 4,368 hours, 10 per ASTM D 714 for blistering; 7 per ASTM D 610 for rusting.

d. Direct Impact Resistance: ASTM D 2794, 160 in. lbs.

e. Flexibility: ASTM D 522, 180 degrees bend, 1 inch mandrel, Passes. Pencil Hardness: ASTM D 3363, 3H.

f. Moisture Condensation Resistance: ASTM D 4585, 100 degrees F, 2000 hours, Passes no cracking or delamination.

g. Dry Heat Resistance: ASTM D 2485, 250 degrees F.

h. Accelerated Weathering: QUV- ASTM D 4587 QUV A 5000 Hours Passes.

i. Salt Fog Resistance: ASTM B 117, 5,600 hours No cracking or blisters Primer Materials: Polyamide epoxy primer as follows:

C. Intermediate Coat: Provide factory applied aliphatic acrylic urethane topcoat in specified color and gloss range per approved samples.

1. Intermediate Coat shall be certified OTC/VOC compliant at less than 2.8 lbs/gal. and conform to EPA and local requirements.

2. Intermediate Coat shall be applied over primer per the manufacturer's recoat schedule at the same galvanizer's plant in a controlled environment meeting applicable environmental conditions as recommended by the coating manufacturer.

3. Aliphatic acrylic urethane Intermediate Coat shall be applied at 4-6 mils DFT and meet or exceed the following performance criteria as stipulated by the coatings manufacturer:

a. Abrasion Resistance: ASTM D 4060, CS17 Wheel, 1,000 cycles 1 kg load, 87.1 mg loss.

b. Adhesion: ASTM D 4541, 1050 psi.

c. Direct Impact Resistance: ASTM D 2794, greater than 28 in. pounds.

d. Dry Heat Resistance: ASTM D 2485, 200 degrees F (93 C).

e. Salt Fog Resistance: ASTM B 117 9,000 hours, Rating 10 per ASTM D 714 for blistering, Rating 9 per ASTM D 610 for rusting.

f. Flexibility: ASTM D522, 180 degrees bend, 1/8 inch mandrel, Passes.

g. Pencil Hardness: ASTM D 3363, F.

h. Moisture Condensation Resistance: ASTM D 4585, 100 degrees F, 1000 Hours, No blistering or delamination.

i. Corrosion Weathering: ASTM D 5894, 21 Cycles, 7056 Hours: Rating 10 per ASTM D714 for blistering. Rating 9 Per ASTM D 610 for Rusting.

j. Thermal Shock: ASTM D 2246, 15 cycles, Excellent.

D. Topcoat: Provide factory applied aliphatic acrylic urethane topcoat in specified color and gloss range per approved samples.

1. Topcoat shall be certified OTC/VOC compliant at less than 2.8 lbs/gal and conform to EPA and local requirements.

2. Topcoat shall be applied over the Intermediate Coat per the manufacturer's recoat schedule at the same galvanizer's plant in a controlled environment meeting applicable environmental conditions as recommended by the coating manufacturer.

3. Fluoropolymer Topcoat will be applied at 2-3 mils DFT and must meet or exceed the following criteria:

a. Adhesion: ASTM D 4541, 2,283 psi.

b. Direct Impact Resistance: ASTM G14, 120 in. pounds.

c. Dry Heat Resistance: ASTM D 2485, 200 degrees F.

d. Salt Fog Resistance: ASTM B 117 5,000 hours, Rating 10 per ASTM D 714 for blistering, Rating 10 per ASTM D 610 for Rusting.

e. Flexibility: ASTM D 522, 180 degrees bend, 1/8 inch mandrel, Passes.

f. Pencil Hardness: ASTM D 3363, F-H.

g. Moisture Condensation Resistance: ASTM D4585, 100 degrees F, 5000 hours, No blisters or rust. No loss of gloss or adhesion.

h. Thermal Shock: 30 cycles, Result- No loss of adhesion, no cracking. Certified OTC/VOC compliant at less than 2.8 lbs/gallon and conform to EPA and local requirements.

E. Clear-coat: Provide factory applied aliphatic acrylic urethane UV resistant clearcoat in specified gloss range per approved samples.

1. Clear-coat shall be certified OTC/VOC compliant at less than 2.8 lbs/gal. and conform to EPA and local requirements.

2. Apply clear-coat shall over the topcoat per the manufacturer's recoat schedule at the same galvanizer's plant in a controlled environment meeting applicable environmental conditions as recommended by the coating manufacturer.

3. Aliphatic acrylic urethane Clear-coat shall be applied at 4-6 mils DFT and meet or exceed the following performance criteria as stipulated by the coatings manufacturer: a. Abrasion Resistance: ASTM D 4060, CS17 Wheel, 1,000 cycles 1 kg load, 55 mg loss. b. Adhesion: ASTM D 4541, 1250 psi. c. Direct Impact Resistance: ASTM D 2794, 120 in. pounds.

F. FACTORY-APPLIED COATINGS FOR METAL 050513 - 5

G. Dry Heat Resistance: ASTM D 2485, 200 degrees F (93 C). e. Salt Fog Resistance: ASTM B 117 3,000 hours, Passes, no blistering or rusting f. Flexibility: ASTM D522, 180 degrees bend, 1/8 inch mandrel, Passes. Pencil Hardness: ASTM D 3363, HB. g. Corrosion Weathering: ASTM D 5894, 9 Cycles, 3000 Hours: Passes- no blistering, cracking, rusting or delamination. h. Accelerated Weathering: ASTM D 4587, QUV-A 10,000 hours- 100% Gloss retention. i. Graffiti Resistance: epoxy ester spray, acrylic spray, alkyd spray, ballpoint pen ink,crayon, lipstick- all easily and completely removed with either xylene or MEK.

PART 3 - EXECUTION

3.1 GALVANIZING

A. Hot dip galvanize using the dry-kettle process in accordance with ASTM A 123 for fabricated products and ASTM A 153 for hardware.

B. Provide thickness of galvanizing specified in schedules and Sections.

C. Fill vent holes after galvanizing and grind smooth.

D. Galvanizing shall exhibit a rugosity (smoothness) 4 rug or less (16-20 microns of variation) when measured by a profilometer over a 1 inch straight line on the surface of elements that are less than 24 pounds per running foot. Profilometer shall be capable of operating in 1 micron increments.

E. Where field restoration of any exposed galvanized surface is required, make repairs according to ASTM-A780, using either method A1 or A3 described in the Annex to achieve a thoroughly bonded coating that is visually uniform with surface and thickness consistent with the shop applied galvanizing.

1. “Zinc-rich” primers are permitted only when furnished as a component of a warranted Duplex Coating System and shall not be used as the sole repair coating.

3.2 APPLICATION OF FACTORY-APPLIED PRIMER

A. Prepare galvanized surface to receive primer and color coats by in-factory blasting per SSPC SP16 to achieve 1 – 3 mil profile with zinc blasting medium or medium that does not leave corrosive inclusions in the treated surface. Abrade inaccessible areas per SSPC SP2 or SP3 to achieve 1 – 3 mil profile.

1. Do not use iron or steel shot, sand, or aluminum oxide grit as a blast medium.

2. Do not use power wire brushes for cleaning and preparation of steel.

B. Apply primer within 12 hours after galvanizing or blasting, at the galvanizer’s facility, in a controlled environment meeting applicable environmental conditions and as recommended by the primer coating manufacturer. Primer shall have a one-year re-coat window for application of finish coat.

C. Polyamide epoxy primer shall be applied at 4-6 mils DFT.

3.3 APPLICATION OF FACTORY-APPLIED FINISH

A. Application of Factory-Applied Intermediate Coat: Apply intermediate coat to hot-dipped galvanized and factory-primed materials in accordance with intermediate coat manufacturer’s recommendations at the same facility where the galvanizing is done in a controlled environment

meeting applicable environmental regulations and as recommended by the intermediate coat manufacturer at 4 - 6 mils DFT.

B. Application of Factory-Applied Top Coat: Apply topcoat over intermediate coat on hot-dipped galvanized and factory-primed materials in accordance with top coat manufacturer's recommendations at the same facility where the galvanizing is done in a controlled environment meeting applicable environmental regulations and as recommended by the topcoat manufacturer at 2 -3 mils DFT.

3.4 INSTALLATION AND STEEL MATERIALS

A. Steel materials, fabrications, and assemblies are specified to be installed in other Sections and as noted on the drawings. See drawings for steel fabrications and assemblies requiring a hot-dip galvanized, primed, and factory-applied color coat finish.

B. Installation: Comply with fabricator's and galvanizer's requirements for installation of materials and fabrications, including use of nylon slings or padded cables for handling factory-coated materials.

3.5 FIELD INSPECTION

A. Inspect installed galvanized materials, fabrications, and assemblies to conform to applicable requirements of AHDGA "Inspection Manual for Hot Dip Galvanized Products", consisting of visual inspection.

3.6 TOUCH UP AND REPAIR

A. Protection: Protect galvanized and finished items from damage until Date of Substantial Completion.

B. Touch-up and Repair: Clean damaged and field-welded coated surfaces, bolted connections and abraded areas, and repair coatings as follows:

1. Repair of damaged galvanized surfaces: Over wire brushed surface, apply 95 percent (by weight) organic zinc rich paint in accordance with ASTM A 780.

    a. Dry film thickness of applied repair paint to be not less than galvanized coating thickness required by ASTM A-123, A-153 or A-386 as applicable.

    b. Touch-up of galvanized surfaces with silver paint, brite paint, or aluminum paints is not acceptable.

2. Touch-up of factory-applied color coats: Applicator shall be responsible for field-touch-up for up to 1 percent of the surface area at no additional expense to the Owner. Touch-up and repair damaged areas such that repair is not visible from a distance of 6 feet.

END OF SECTION 05 05 13

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PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide all labor, materials, necessary equipment and services to complete the structural steel work and related work, called for in this Section of the Specifications, including but not necessarily limited to the following:

1. Furnishing and erecting structural steel.

2. Standard and special connections, including angles, plates, high-strength bolts, washers, and inserts.

3. All steel support angles, plates, bolts, inserts for cast in place concrete, etc., which are attached to the structure.

4. All welding where required.

5. Delivery of bearing plates, anchor bolts and loose lintels to the site for installation by others.

6. Shop and Field Painting

1.2 QUALITY ASSURANCE

A. All work of this Section shall be provided in accordance with the latest edition of the following:

1. AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

2. AISC Code of Standard Practice.

3. 2018 State of Connecticut Building Code.

1.3 SUBMITTALS

A. Submit for review, prior to fabrication, anchor bolt and erection plans and shop drawings for all structural steel showing the kind of material, steel certification, sizes of members, details of pieces, and methods of securing same together.

B. Submit for review, prior to fabrication, anchor bolt and erection plans and shop drawings for all structural steel showing the kind of material, steel certification, sizes of members, details of pieces, and methods of securing same together.

C. Structural steel supplier is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to the fabrication processes or to techniques of construction and for coordination of the work of other trades. Erection plans shall be reviewed and all dimensions coordinated, before any piece detail drawings are begun.

D. Submit for review, qualifications of welder performing shop and field welding.

E. Substitution of sections or modifications of details shall be made only when approved by the Engineer in writing.

F. No structural drawings shall be reproduced as shop drawings.

G. Connecticut High Performance Building Submittals:

1. Recycled Content: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All structural steel shall be new, clean, free from defects impairing strength, durability and appearance, and be of the best commercial quality for purpose specified.

1. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 50 percent.

B. All steel shall conform to the requirements of ASTM A36, A572 Grade 50, ASTM A992, ASTM A500, grade B, or ASTM A501.

C. High-strength bolts, including nuts and washers, shall comply with ASTM A325 OR A490. Minimum dimensions for bolts, washer, beveling, etc., shall comply with the requirements of the "Specifications for Structural Joints using ASTM A325 Bolts". All bolts shall be bearing type.

D. Welding electrodes shall be as approved for use with ASTM A36, A50, ASTM A500, grade B, or ASTM A501 under the AISC Specification.

PART 3 - EXECUTION

3.1 FABRICATION

A. All shop fabrication shall conform to Section M2, AISC Specification. All members shall be free of twists, kinks, buckled or open joints. Shearing and punching shall be without ragged or torn edges. Holes shall be enlarged only by reaming. Burning of holes will not be permitted.

B. Unless otherwise noted, make all connections in accordance with the AISC Manual of Steel Construction. All shop connections shall be welded using double angles, except where otherwise noted.

C. All welding, shop and field, shall be performed only by procedures and welders qualified in accordance with standards for workmanship of the American Welding Society.

D. The Steel Fabricator shall be AISC Quality Certified Category 1 or 2 for Steel Structures or a member of the Structural Steel Fabricators of New England.

E. All exposed lintels or steel framing shall be hot dipped galvanized unless noted otherwise.

F. Framing connections shall be designed for ½ the maximum UDL load unless otherwise indicated on the plans. Connections shall be designed by a Licensed Professional Engineer registered in the State of Connecticut. Connections shall be submitted for review and approval.

3.2 SHOP PAINTING

A. All structural steel is to be given one coat of shop primer prior to shipment in accordance with Chapter M3 of the AISC Specifications**.** Primer shall be modified alkyd primer or acceptable equivalent, conforming to primer specifications as listed in Steel Structures Painting Council Paint System Specifications. Structural steel to be fireproofed is not to be primed.

B. Omit shop primer from areas requiring field welding or at locations where spray applied fireproofing is required.

C. Coordinate primer type for compatibility with paint top coat.

3.3 ERECTION

A. Erection of steel shall be done in conformance with Section 7 of AISC "Code of Standard Practice."

1. All structural framing shall be accurately set and secured in position.
2. All structural steel work shall be maintained in its position with adequate bracing and guying until all permanent field connections are completed. Guying shall not be removed without written permission from Engineer.
3. All steel required to be plumb and level within a tolerance of 1:500.

B. All field connections shall be bolted with A325-N type high strength bolts and washers or welded where required. All bolts shall be 3/4" minimum.

1. High strength bolts shall be installed with hardened washers. Nuts shall be tightened by calibrated torque wrenches in conformity with minimum bolt tension values established in the "Specifications for Joints using ASTM A325 Bolts".

C. Burned holes will not be permitted for any bolted connections.

D. Temporary bracing for the steel frame shall be designed to support all loads to which the structure may be subjected, including wind, impact from erection equipment and its operation, and as required by applicable codes. Such bracing shall be left in place as long as required for safety.

E. No field welding shall be done when the temperature is less than 15 degrees F.

F. All galvanized steel that has been field welded shall be touched up with galvanized repair paint.

3.4 INSPECTION

A. The material to be furnished under the section shall be subject to inspection and tests in the shop and field.

B. The testing agency shall have access to all quality control data.

C. High-strength bolts will be tested in accordance with Research Council Specification for A325 Bolts. All bolts in every connection will be tested. In the event that inspections reveal bolts to be undersized, loose or defective, the cost of re-bolting and re-testing shall be at the structural steel supplier's expense.

END OF SECTION 05 12 00

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. Loose bearing and leveling plates.
2. Loose steel lintels where shown by Drawings.
3. Steel framing and supports for mechanical and electrical equipment.
4. Steel weld plates and angles for casting into concrete not specified in other Sections.
5. Steel framing and supports for applications where framing and supports are not specified in other Sections.
6. Slotted channel framing.
7. Stainless Steel fabrications

1.3 SUBMITTALS

A. Product Data: For the following:

1. Slotted channel framing.
2. Grating.
3. Paint products.
4. Grout.
5. Stainless steel passivation method

B. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
2. Provide templates for anchors and bolts specified for installation under other Sections.
3. For miscellaneous metal fabrications specified in this Section indicated to comply with design loads typical of miscellaneous framing and bracing, framing and supports for overhead doors, and slotted channel equipment support framing, include structural analysis and calculations, and shop drawings signed and sealed by the qualified professional structural engineer responsible for their preparation and who is licensed in Connecticut. 2

C. Qualification Data:

1. For firms and persons specified in "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.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Slotted Channel Framing:

1. Installer: Installer trained and authorized by slotted channel framing manufacturer to install product, and with not less than five (5) years experience in installations of slotted channel framing of the size and configuration included in this Project.

2. Source: Procure all slotted channel framing components including fasteners through one source from one manufacturer.

C. Metal Bar Grating Standards: Comply with NAAMM MBG 531, "Metal Bar Grating Manual" and NAAMM MBG 532, "Heavy-Duty Metal Bar Grating Manual."

D. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."

2. AWS D1.2, "Structural Welding Code--Aluminum."

3. AWS D1.3, "Structural Welding Code--Sheet Steel."

4. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

E. Performance Requirements:

1. Structural Performance of Miscellaneous Framing and Supports: Provide miscellaneous framing and supports capable of withstanding applied loads and stresses.

2. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

a. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.5 PROJECT CONDITIONS

A. Field Measurements: Where metal fabrications are indicated to fit walls and other construction, verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.6 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. As part of the Base Bid coordinate design of miscellaneous steel framing and supports provided under requirements of this Section with the design and fabrication of primary structural systems and other construction to which they will be connected.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: For metal fabrications exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

2.2 FERROUS METALS

A. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.

B. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

D. Steel Tubing: Cold-formed steel tubing complying with ASTM A 500.

E. Steel Pipe: ASTM A 53, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

F. Slotted Channel Framing: As specified below.

G. Malleable-Iron Castings: ASTM A 47, Grade 32510.

H. Gray-Iron Castings: ASTM A 48, Class 30, unless another class is indicated or required by structural loads.

2.3 ALUMINUM

A. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

C. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

D. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.4 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Shear and punch metals cleanly and accurately. Remove burrs.

C. Ease exposed edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

E. Provide for anchorage of type indicated, coordinate with supporting structure. Fabricate and space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

F. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

G. Fabricate joints that will be exposed to weather in a manner to exclude water or provide weep holes where water may accumulate.

H. Allow for thermal movement resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

I. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.

J. Remove sharp or rough areas on exposed traffic surfaces.

K. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Use exposed fasteners of type indicated or, if not indicated, Phillips flat-head (countersunk) screws or bolts. Locate joints where least conspicuous.

2.5 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports that are not a part of structural framework as necessary to complete the Work.

B. Fabricate units from structural-steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors 1-1/4 inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long at 24 inches (600 mm) o.c., unless otherwise indicated.
2. Furnish inserts if units must be installed after concrete is placed.

C. Hot-dip galvanize interior miscellaneous steel framing and supports where indicated and all exterior miscellaneous steel framing and supports after fabrication.

D. Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

1. Where field welds and repairs of galvanized steel parts and lintels is required, coat all such areas with 2 coats of zinc rich paint.

2.6 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates after fabrication.

2.7 LOOSE STEEL LINTELS

A. Fabricate loose structural-steel lintels from steel angles, tees, plates, and other shapes of size indicated for openings and recesses in masonry walls and partitions at locations where steel lintels are indicated.

B. Weld adjoining members together to form a single unit where indicated.

C. Size loose lintels to provide bearing length at each side of openings equal to one-twelfth of clear span, but not less than 8 inches (200 mm), unless otherwise indicated.

D. Hot-dip galvanize loose steel lintels after fabrication where located in exterior walls.

E. Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

1. Where field welds and repairs of galvanized steel lintels is required, coat all such areas with 2 coats of zinc rich paint.

2.8 SLOTTED CHANNEL FRAMING

A. Basis-of-Design: The basis-of-design for slotted channel framing is Unistrut Corp.: Unistrut with Perma-Green finish. Subject to compliance with requirements, provide the named product or comparable products of one of the following manufacturers:

1. Anvil International: Anvil-Strut.
2. ABB / Thomas and Betts: Superstrut.
3. Carpenter and Paterson Inc.: Multistrut.
4. Eaton Corporation: Eaton B-Line.
5. Pentair: Eristrut Strut Channel System.
6. Haydon Corp.: H Strut.
7. Unitron Products Inc.: US-Strut.
8. Wesamco Inc.: Westrut.

B. Slotted Channel Framing: Cold-formed metal box channels complying with MFMA-4 and fabricated from steel complying with ASTM A 653/A 653M, structural quality, Grade 33 (Grade 230) with flange edges returned toward web and with 9/16-inch- (14.3-mm-) wide slotted holes in webs at 2 inches (51 mm) o.c., and with all fittings, bolts and nuts required for assembly.

1. Framing Members:

a. Channels: 1-5/8 inches (41 mm) width by 1-5/8 inches depth with clamping ridges on each side.

b. Thickness of Metal: Base metal thickness as required by analysis to withstand design loads but not less than 0.108 inch (2.7 mm).

2. Finish: Manufacturer's standard thermoset acrylic coating.

C. Anchors:

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors 1-1/4 inches (32 mm) wide by 1/4 inch (6 mm) thick by 8 inches (200 mm) long at 24 inches (600 mm) o.c., unless otherwise indicated.

2. Furnish inserts if units must be installed after concrete is placed, and for anchorage of units to existing concrete.

2.9 STAINLESS STEEL SILLS AND COUNTERS

A. Fabricate sills and counters from grade 316 stainless steel sheet no less than 14 gauge (.07812 inch thick), ¼ hard temper, No 4 directional finish parallel to the long dimension. Surface roughness of new or worked surfaces shall not exceed Ra 25 micro-inches.

B. Brake-form right angle edges to minimum radii, in general no tighter than .08 inch.

C. Weld returns, reinforcements and attachment clips using techniques and processes that prevent buckling, distortion, and warping. Remove weld scale and heat tint in accordance with ASTM A380. Grind welds visible-in-use flush with the surface, matching radii and blending finish pattern. Passivate all disturbed surfaces with electro chemical or pickling paste media.

D. Ship and install with protective strippable film.

2.10 FASTENERS

A. General: Provide Type 304 or 316 stainless-steel fasteners for aluminum fabrications and exterior use, and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, where built into exterior walls. Select fasteners for type, grade, and class required.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 1 or 2.

D. Anchor Bolts: ASTM F 1554, Grade 36.

E. Eyebolts: ASTM A 489.

F. Machine Screws: ASME B18.6.3 .

G. Lag Bolts: ASME B18.2.1.

H. Wood Screws: Flat head, steel, ASME B18.6.1.

I. Plain Washers: Round, steel, ASME B18.22.1.

J. Lock Washers: Helical, spring type, steel, ASME B18.21.1.

K. Toggle Bolts: FS FF-B-588, tumble-wing type, class and style as needed.

L. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed

in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Material: Alloy Group 1 or 2 stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

M. Cast-in-Place Anchors in Concrete: Anchors of type indicated below, fabricated from corrosion-resistant materials capable of sustaining, without failure, the load imposed within a safety factor of 4, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47 malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

N. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

2.11 GROUT

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.12 CONCRETE FILL

A. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.

2.13 PAINT

A. Shop Primer for Ferrous Metal: Organic zinc-rich primer, complying with SSPC-Paint 20 and compatible with topcoat.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Carboline 621; Carboline Company.

b. Aquapon Zinc-Rich Primer 97-670; PPG Industries, Inc.

c. Tneme-Zinc 90-97; Tnemec Company, Inc.

B. Galvanizing Repair

1. Paint: is acceptable only in concealed locations with prior approval.

2. Repair damaged galvanizing according to ASTM A780, 4.2.1, and Appendix A1 or A3 only.

C. Bituminous Paint: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat; or cold-applied asphalt emulsion complying with ASTM D 1187. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers whose products may be incorporated in the Work of this Section include, but are not limited to the following:

a. Karnak Corp.

b. Euclid Chemical Co.

c. Henry Co.

d. W R Meadows, Inc.

2.14 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

2.15 STEEL AND IRON FINISHES

A. Hot-dip galvanize and prime and apply color coat finishes to items indicated after fabrication in compliance with requirements of Division 5 Section “Factory-Applied Metal Coatings” and as specified below:

1. ASTM A 123, for galvanizing steel and iron products.

2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

B. Preparation for Shop Priming of Non-Galvanized Metal Fabrications: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:

1. Exteriors (SSPC Zone 1B): SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

C. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

D. Painted Finish: Comply with Division 9 Section “Painting.”

1. Color: As selected by Architect from manufacturer's full range.

2.16 ALUMINUM FINISHES

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

1. As-Fabricated Finish: AA-M10 (Mechanical Finish: as fabricated, unspecified).

2.17 STAINLESS STEEL FINISHES

A. Finish stainless assemblies exposed to view to NOMMA #4 parallel to the long dimension.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal fabrications to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 SETTING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations, unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 INSTALLATION OF MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings, if any.

B. Do not anchor miscellaneous metal framing to permanent metal forms, floor deck, steel deck tabs, or steel roof deck. Anchor to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, power-actuated fasteners that extend through forms into concrete, or to structural members.

C. Anchor firmly in place, and tighten all connections to recommended torque.

D. Anchor supports for operable partitions securely to and rigidly brace from building structure.

3.4 INSTALLATION OF SLOTTED CHANNEL FRAMING

A. Installation shall be only by fully trained and manufacturer authorized installer.

B. Install slotted channel framing to comply with requirements of items being supported, including requirements set out in manufacturer's written instructions and requirements indicated on Shop Drawings, if any.

C. Set slotted channel framing components into final position true to line, level and plumb, in accordance with approved shop drawings.

D. Do not anchor slotted channel framing to permanent metal forms, floor deck, steel deck tabs, or steel roof deck. Anchor slotted channel framing to cast-in-place hanger inserts, post-installed mechanical or adhesive anchors, power-actuated fasteners that extend through forms into concrete, or to structural members.

E. Anchor slotted channel framing firmly in place and tighten all connections to recommended torque.

3.5 INSTALLATION OF STAINLESS FABRICATIONS

A. Fabricate stainless steel assemblies to avoid field welding and finishing.

B. Arrange installation to fit to supporting construction, with concealed clips or fasteners.

C. For assemblies exposed to weather, provide integral drains and weeps.

D. Protect stainless steel surfaces during masonry wash down. If surfaces come in contact with masonry cleaners, neutralize, clean with mild detergent, and passivate.

3.6 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 Section "Painting."

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 00

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. Furnish and install exterior steel pipe and tube guard railings and steel pipe handrails.
2. Furnish and install exterior steel pipe and tube separation railings.
3. Furnish and install exterior steel pipe vehicle barrier gate with hinge post.
4. Provide factory-applied hot dip galvanizing, factory-applied-primer, and factory applied finish coat to railings and fittings prior to installation, as specified in Section 05 05 13.

B. Related Requirements:

1. Section 12 93 00 – Site Furnishings for metal pipe bollards.
2. Section 32 13 13 – Concrete Paving.
3. Section 05 05 13 – Factory-Applied Metal Coatings for hot dip galvanizing and factory-applied-primer and factory-applied finish coat.
4. Division 1 Section 01 78 30 – “Warranties and Bonds” for warranty requirements applicable to the work of this Section.

1.3 COORDINATION

A. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

B. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

C. Coordination between Fabricator and Galvanizer: Prior to fabrication and final submittal of shop drawings to Architect, fabricator to submit shop drawings to the galvanizer for all metal fabrications to receive factory-applied metal coatings. Galvanizer to review fabricator’s shop drawings for suitability of materials for galvanizing and coatings and coordinate any required modifications to fabrications required to be performed by the fabricator.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Railing brackets.
2. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.
3. Initial Selection and Verification Samples of Factory-Applied Metal Coatings: Submit two 3 inch by 3 inch samples of factory-applied coatings and colors proposed for use for approval prior to coating application.
4. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
   a. Show method of connecting and finishing members at intersections.

D. Connecticut High Performance Building Submittals:
1. Recycled content materials.
2. Local materials.

E. Qualification Data: For testing agency.

F. Welding certificates.

G. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

H. Evaluation Reports: For post-installed anchors, from ICC-ES.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.8 WARRANTY

A. Warranty Period:
1. Hot-Dip Galvanizing: As specified in Section 01 78 30 “Warranties and Bonds”.
2. Factory-Applied Primer and Finish Coat: As specified in Section 01 78 30 “Warranties and Bonds ”.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide guardrails, handrails and railings capable of withstanding structural loads required by the Connecticut State Building Code without exceeding allowable

design working stresses of materials for guardrails, handrails, anchors and connections. Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and top rails of Guards:
    a. Uniform load of 50 lbf/ ft. applied in any direction.
    b. Concentrated load of 200 lbf applied in any direction.
    c. Uniform and concentrated loads need not be assumed to act concurrently.
2. Limit deflection of post members to H/60 and rail members to L/360.
3. Infill of Guards:
    a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
    b. Infill oad and other loads need not be assumed to act concurrently.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg., ambient; 180 deg. F material surfaces.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.3 STEEL AND IRON

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

C. Tubing: ASTM A 500 (cold formed) or ASTM A 513, .1875” wall thickness, unless another wall thickness is required by structural loads.

D. Plates, Shapes, Channels and Bars: ASTM A 36/A 36M

E. Flanges: Decorative flanges are to match the material and finish of the post tubing, in either square or round shape, with set screw.

2.4 FASTENERS

A. General: Provide the following:

1. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
2. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

B. Fasteners for Anchoring railing to other construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select per AWS specifications for metal alloy welded.

1. Coordinate with galvanizer to ensure that materials are compatible with the galvanizing process to be used, and weld distortion minimized.

2. Low silicon and manganese rods typically provide the best results.

B. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's (formerly, the California Department of Health Services') "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

F. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.

G. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.

H. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

I. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for exterior applications.

J. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project Site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings. Coordinate with galvanizer to ensure that materials used are compatible with the galvanizing process to be used.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove flux immediately.

4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

5. Weld joint to match weld "Type I" of the national Ornamental & Miscellaneous Metals Association (NOMMA) voluntary joint finish standards.

I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Utilize splice joints with pipe sleeve lock for field connection.

2. Butt joints shall be hairline tight.

3. Tamper resistant recessed set screw shall lock sleeve in place.

4. No field welding shall be allowed.

J. Form Changes in Direction as Follows:

1. As detailed.

2. By bending.

3. By radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated.

K. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of railing members with prefabricated end fittings.

M. Brackets, Flanges, Fittings, and Anchors: Provide brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated. **Flange shall match the material and finish of the post.**

N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

O. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

P. For Exterior Railings: Fabricator shall submit shop drawings of non-standard fabrications, fabrications involving any dimension which exceeds the size of the galvanizer's kettle, and any fabrication to determine the suitability of the material for the specified metal coating.

Q. Vent holes shall be plugged smooth with surface after the galvanizing process, but prior to factory-applied primer and factory-applied finish coat.

2.7 HOT DIP GALVANIZING AND FACTORY-APPLIED ARCHITECTURAL FINISH

A. Conform to Section 05 05 13 – Factory-Applied Metal Coatings for hot dip galvanizing and factory-applied finish coat. All exterior railings and fittings shall be hot-dip galvanized with factory-applied primer and factory-applied finish coat unless specifically indicated otherwise.

B. Color: Color as selected by Architect from manufacturer's full range including standard colors, premium colors, custom colors, exotic colors and metallic colors.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

2. Set posts plumb within a tolerance of 2 mm in 1 m (1/16 inch in 3 feet).

3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 6 mm in 3.5 m (1/4 inch in 12 feet).

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

F. Comply with Fabricator's and Galvanizer's requirements for installation of materials and fabrications, including the use of nylon slings or padded cables for handling factory-coated materials.

3.2 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints not farther apart than required to accommodate thermal movement. Expansion joints shall be hairline type butt joints. Provide slip-joint internal sleeve extending a minimum of 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 12 inches of post.

3.3 ANCHORING POSTS

A. Form or core-drill holes not less than 8 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Cover anchorage joint with flange of same metal as post, attached to post with set screws.

3.4 VEHICLE BARRIER GATE

A. Install steel vehicle barrier gate and hinge post with a concrete footing to the size and depth indicated in the drawings.

3.5 ADJUSTING AND CLEANING

A. Conform to Article 3.6, Section 05 05 13 Factory-Applied Metal Coatings for touch-up and repair of hot-dip galvanizing and factory-applied finish coat.

3.6 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

3.7 CORRECTION OF ERRORS OR DEFECTS

A. Accurate field measurements of installation locations prior to fabrication or manufacture should enable a satisfactory fit of architectural metal fabrications.

B. Any corrective measures must be approved and accepted by the Architect.

END OF SECTION 05 52 13

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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. Framing with dimension lumber.
2. Wood blocking and nailers.
3. Wood furring.
4. Wood sleepers.
5. Utility shelving.
6. Roof sheathing.
7. Plywood backing panels.

B. Related Sections include the following:

1. Division 6 Section "Finish Carpentry" for nonstructural carpentry items exposed to view and not specified in another Section.

1.3 DEFINITIONS

A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise indicated.

B. Exposed Framing: Framing not concealed by other construction.

C. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

D. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. RIS: Redwood Inspection Service.
4. SPIB: The Southern Pine Inspection Bureau.
5. WCLIB: West Coast Lumber Inspection Bureau.
6. WWPA: Western Wood Products Association.

1.4 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

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. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments specified to be High-Temperature (HT) type, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

C. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

D. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Powder-actuated fasteners.
5. Expansion anchors.
6. Metal framing anchors.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

B. Source Limitations for Engineered Wood Products: Obtain each type of engineered wood product through one source from a single manufacturer.

C. Source Limitations for Fire-Retardant-Treated Wood: Obtain each type of fire-retardant-treated wood product through one source from a single producer.

D. Forest Certification: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":

1. Dimension lumber framing.
2. Miscellaneous lumber.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
4. Provide dressed lumber, S4S, unless otherwise indicated.

B. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.

1. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
2. Factory mark panels to indicate compliance with applicable standard.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA C2 for lumber and AWPA C9 for plywood, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).

1. Preservative Chemicals: Acceptable to authorities having jurisdiction, containing no arsenic or chromium, and one of the following:
   a. Ammoniacal, or amine, copper quat (ACQ).
   b. Copper bis (dimethyldithiocarbamate) (CDDC).
   c. Ammoniacal copper citrate (CC).
   d. Copper azole, Type A (CBA-A).
   e. Copper azole, Type B (CA-B).
   f. Oxine copper (copper-8-quinolinolate) in a light petroleum solvent.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber and plywood with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Items of exterior construction including but not limited to wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.

4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.

5. Wood floor plates that are installed over concrete slabs-on-grade.

6. Plywood items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Provide fire-retardant-treated-materials for all interior rough carpentry complying with the following, unless otherwise indicated.

1. Manufacture fire-retardant-treated-materials in accordance with established standards for treating and redrying, and under inspection by UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction

2. When tested in accordance with ASTM E 84 interior and exterior fire-retardant materials:

a. Have flame spread less than 25.

b. Show no evidence of significant progressive combustion when test is continued for an additional 20 minute period.

c. Flame front does not progress more than 10-1/2 feet beyond centerline of burners at any time during the test.

3. Materials treated with exterior type fire retardant shall exhibit no increase in the listed classification when subjected to ASTM D 2898 Standard Rain Test.

4. Kiln dry fire-retardant-treated-materials to a moisture content not exceeding:

a. 19 percent for lumber.

b. 15 percent for plywood.

5. Use treatment that does not promote corrosion of metal fasteners.

6. Use Exterior type, organic-resin-based formulation thermally set in wood by kiln-drying for all locations requiring fire-retardant-treated materials.

a. Milling of lumber after treatment is only permissible within limits set for wood removal that does not affect listed fire-test-response characteristics, and as follows:

1) Cutting of lumber to length: Cross-cutting, end cuts, holes and joints such as tongue and groove, bevel, scarf and lap, and corbels on rafter tails are allowed.

2) Ripping: Ripping of lumber: along the length, such as ripping a 2x4 into 2x2's is not permitted.

3) Stair Stringers: Cutting of stair stringers after treatment is not permitted because the effect is similar to ripping.

4) Milling or resurfacing of lumber: Not permitted. If special shapes or thickness for fire-retardant-treated lumber are required, milling shall be done prior to treatment.

5) Cutting of plywood in any direction: Allowed by without restriction.

6) Light sanding of lumber or plywood: Permitted only to the extent to remove raised grain or to prepare for finishing.

7) End coating: Not required.

B. Identify fire-retardant-treated wood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction, and showing the following:

1. Identification of the manufacturer.
2. Name of the treatment.
3. Species of wood.
4. Flame Spread and Smoke Developed index.
5. Method of drying.
6. If treated with EXTERIOR type fire retardant treatment, show the words, “No increase in the listed classification when subjected to the Standard Rain Test (ASTM D2898)”.

2.4 DIMENSION LUMBER FRAMING AND MISCELLANEOUS LUMBER

A. General: Provide dimension lumber for framing and miscellaneous lumber indicated and lumber for support or attachment of other construction.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 15 percent maximum moisture content and any of the following species:

1. Mixed southern pine; SPIB.
2. Northern species; NLGA.
3. Eastern softwoods; NeLMA.
4. Western woods; WCLIB or WWPA.

C. Fire Retardant-Treated Lumber: For items of interior construction and as specified in Article 2.3 “Fire Retardant Treated Materials” of this Specification.

D. Wood Preservative Treated Lumber: For items of exterior construction and as specified in Article 2.2 “Wood Preservative Treated Lumber” of this Specification.

E. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

F. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

G. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 ROOF SHEATHING AND DECKING

A. Plywood Roof Sheathing: Exterior, Structural I sheathing.

1. Span Rating: Not less than 48/24.

2. Nominal Thickness: As shown by Drawings but not less than 3/4 inch.

3. Edge Configuration: Tongue and Groove

2.6 PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exterior, AC, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Lag Bolts: ASME B18.2.1.

G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

H. Tapcons: ASTM E488.

I. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2. Material: Stainless steel at locations exposed to weather and/or ground contact, where anchoring wood pressure-preservative treated materials, in areas of high humidity and

other locations indicated, with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.8 METAL FRAMING ANCHORS

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

1. Cleveland Steel Specialty Co.
2. Harlen Metal Products, Inc.
3. KC Metals Products, Inc.
4. Simpson Strong-Tie Co., Inc.
5. Southeastern Metals Manufacturing Co., Inc.
6. USP Structural Connectors.

B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those of products of manufacturers listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

C. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

1. Use for interior locations where stainless steel is not indicated.

D. Stainless-Steel Sheet: ASTM A 666, Type 304.

1. Use for wood preservative treated lumber.

2.9 MISCELLANEOUS MATERIALS

A. Multipurpose Construction Adhesive: Elastomeric formulation complying with ASTM D 3498, APA AFG-01, and ASTM C557 that is approved for use indicated by manufacturers of both adhesives and products to be joined.

1. Use adhesive that has a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Manufacturer: Subject to compliance with requirements, provide products of one of the following manufacturers:
   a. Loctite brand of the Henkel Corporation.
   b. DAP Products, Inc.
   c. Degussa Building Systems.
   d. Fastenal Company.
   e. Franklin International.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.

D. Do not splice structural members between supports, unless otherwise indicated.

E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

F. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.

2. Use copper naphthenate for items not continuously protected from liquid water.

H. Securely attach rough carpentry work and sheathing to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.

2. Published requirements of metal framing anchor manufacturer.

3. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

I. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

J. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

1. Comply with approved fastener patterns where applicable.

3.2 WOOD GROUND, SLEEPER, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work. Install 1-by-2-inch nominal- size furring vertically and/or horizontally at 16 inches o.c. unless otherwise indicated.

3.4 SHEATHING

A. General: Comply with applicable recommendations in APA Form No. E30S, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Sheathing: Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.

C. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

D. Coordinate roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

G. Fastening Methods: Fasten panels as indicated below:

1. Roof Sheathing:

   a. Nail to wood framing.

   b. Space panels 1/8 inch (3 mm) apart at edges and ends.

3.5 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturers written instructions.

1. Prime substrates as recommended by flashing manufacturer.

2. Lap seams and junctures with other materials at least 4 inches, except that at flashing flanges of other construction, laps need not exceed flange width.

3. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

3.6 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 00

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The General Conditions and Supplementary General Conditions shall form a part of this and all other sections of the Specifications.

1.2 SUMMARY

A. Provide all labor, materials, necessary equipment and services to complete the work called for in this Section or as shown on the plans, including but not necessarily limited to the following:

1. Shop fabricated wood trusses for roof framing.

2. Bridging, bracing, and anchorage, hurricane clips.

B. Related Work: The following work contains requirements that may refer to this section.

1. Division 6 "Rough Carpentry"

1.3 REFERENCES

A. ALSC - American Lumber Standards Committee: Softwood Lumber Standards.

B. ASTM A167 - Stainless and Heat Resisting Chromium - Nickel Steel Plate, Sheet, and Strip

C. ASTM A446 - Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.

D. AWPA (American Wood Preservers Association) C1 - All Timber Products Preservative Treatment by Pressure Process.

E. NFPA: National Forest Products Association.

F. SPIB: Southern Pine Inspection Bureau.

G. AITC - American Institute of Timber Construction

H. NFPA - National Forest Products Association

I. TPI (Truss Plate Institute) HET - Handling and Erecting Wood Trusses.

J. TPI (Truss Plate Institute) TPI - Metal Plate Connected Wood Trusses.

K. TPI (Truss Plate Institute) QST - Metal Plate Connected Wood Trusses.

L. WWPA: Western Wood Products Association.

1.4 SYSTEM DESCRIPTION

A. Design roof live and dead load: The roof trusses shall be designed form the following minimum gradity loads:

Top Chord	**30 psf LL snow**
Top Chord	**15 psf DL**
Top Chord	**Wind pressures in accordance with the 2018 CT Building Code.**
Bottom Chord	**10 psf DL**

Deflection limited to L/300. Truss designer shall verify the location and magnitude of all truss supported mep equipment with mep drawings. These loads are to be included in the analysis of roof trusses.

B. Maximum truss spacing 24 inches.

1.5 SUBMITTALS

A. Shop Drawings: Indicate sizes and spacing of trusses, loads and truss cambers, framed openings and webs. Submit all design calculations and computer data. Shop drawings and computions are to be prepared under the direction of an engineer registred in the State of Connecticut. All computations and shop drawings are to be stamped.

B. Product Data: Provide truss Configurations, bearing and anchor details, bridging and all bracing details.

1.6 QUALITY ASSURANCE

A. Perform work in accordance with the following agencies:

1. Lumber Grading Agency: Certified by ALSC.

2. Truss Plate Institute: Certified by TPI

B. Truss design, fabrication, and installation: In accordance with Truss Plate Institute BWT, HET, PCT.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with a minimum three years documented experience.

B. Design trusses under the direct supervision of a Professional Structural Engineer experienced in design of this type of work and licensed in the State of Connecticut. All submitted design computations and shop drawings shall bear a signed stamp of the Professional Engineer.

1.8 REGULATORY REQUIREMENTS

A. The design of all trusses shall conform to the 2018 Connecticut Building Code. Wind loads and corresponding pressures shall be determined from a minimum wind speed for the Town of Groton.

1.9 DELIVERY AND STORAGE REQUIREMENTS

A. Handle and erect trusses in accordance with TPI HET.

1.10 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on the shop drawings.

PART 2 - PRODUCTS

2.2 MATERIALS

A. Species (Commercial Design): Douglas Fir, Larch or Southern Yellow Pine.

B. Timber minimum design allowable stresses shall be as required to support all design loads including erection loads.

C. Lumber Grading Rules: SPIB and WWPA.

D. Steel Connectors: ASTM A446 steel, Grade B, hot dipped galvanized; die stamped with integral teeth.

E. Truss Bridging: Type, size and spacing recommended by the truss manufacturer. Truss manufacturer is responsible for providing all truss bridging necessary to resist loads outlined on the design drawings, and any anticipated temporary loads during erection.

2.3 ACCESSORIES

A. Wood Blocking, Support Members and Framing for Openings: In accordance with Division 6 " Rough Carpentry ". Southern pine or Douglas fir species, construction grade, 19 percent maximum and 7 percent minimum moisture content.

B. Fasteners: Hot dipped galvanized, type to suit application.

2.4 FABRICATION

A. Fabricate trusses to achieve structural requirements specified.

B. Brace wood trusses in accordance with TPI BWT.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that supports and openings are ready to receive trusses.

3.2 PREPARATION

A. Coordinate placement of bearing and support items.

3.3 ERECTION

A. Install trusses in accordance with the manufacturer's instructions.

B. Set members level and plumb, in correct position.

C. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure plumb, and in true alignment until completion of erection and installation of permanent bracing.

D. Do not field cut or alter structural members without approval of the Engineer. Any field modifications to the trusses shall be submitted to the Design Engineer and Engineer of Record for approval.

E. Place headers and supports to frame openings required.

F. Frame openings between trusses with lumber in accordance with Section 06100.

G. Coordinate placement of decking with work of this section.

H. After erection, touch-up galvanized surfaces with zinc primer.

I. Hurricane clips are to be provided at all truss bearing points. The clips utilized shall have the capacity to support the uplift loads indicated on the truss design drawings prepared by the truss manufacturer. The contractor shall submit certification that all clips meet the load requirements provided by the truss manufacturer.

J. The truss designer is responsible for coordinating the location and magnitude of all mep loads that will be hung from either the top or bottom chords of the timber trusses. No mep equipment is to be hung from the timber trusses without written approval from the truss designer.

3.4 TOLERANCES

A. Framing Members: 1/2 inch maximum, from true position.

END OF SECTION 06 17 53

ISSUED for BID

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. Perimeter insulation under slabs-on-grade.
2. Perimeter wall insulation (supporting backfill).
3. Concealed building insulation.
4. Firesafing insulation.

B. Related Sections include the following:

1. Division 4 Section "Unit Masonry Assemblies" for insulation installed in cavity walls.
2. Division 7 Section "Self-Adhering Sheet Waterproofing" for insulation and insulated drainage panels installed with waterproofing.
3. Division 7 Section "Through-Penetration Firestop Systems" for safing insulation and accessories to the extent not specified in this Section.
4. Division 23 Section "Mechanical Insulation."

1.3 DEFINITIONS

A. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers; produced in boards and blanket with latter formed into batts (flat-cut lengths) or rolls.

1.4 PERFORMANCE REQUIREMENTS

A. Plenum Rating: Provide glass-fiber insulation where indicated in ceiling plenums whose test performance is rated as follows for use in plenums as determined by testing identical products per "Erosion Test" and "Mold Growth and Humidity Test" described in UL 181, or on comparable tests from another standard acceptable to authorities having jurisdiction.

1. Erosion Test Results: Insulation shows no visible evidence of cracking, flaking, peeling, or delamination of interior surface of duct assembly, after testing for 4 hours at 2500-fpm air velocity.
    a. Mold Growth and Humidity Test Results: Insulation shows no evidence of mold growth, delamination, or other deterioration due to the effects of high humidity, after inoculation with Chaetomium globosium on all surfaces and storing for 60 days at 100 percent relative humidity in the dark.

1.5 SUBMITTALS

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

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.

C. Certificates:

1. For foam plastic insulation, certifying compatibility of foam plastic insulation and accessory materials with Project materials that connect to or that come in contact with the barrier; signed by product manufacturer.

a. Certify compliance of wall assembly as a system including foam plastic insulation and accessory materials included as part of the Work of this Section with fire performance requirements of NFPA 285.

D. Research/Evaluation Reports: For foam-plastic insulation.

E. Connecticut High Performance Building Submittals:

1. Recycled Content: Provide data showing postconsumer and preconsumer recycled materials content of materials and fabricated items provided for this project, stated as a percentage of the materials included in these items or materials provided as part of the Work of this Section.

2. Regional Materials: Provide data showing materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

3. VOC Content: For adhesives, including printed statement of VOC content.

4. Cradle to Cradle Certification: Provide documentation showing materials that are Cradle to Cradle Certified products. Include material costs and level of certification for this project.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Surface-Burning Characteristics: ASTM E 84.

a. Fire-Resistance Ratings: ASTM E 119.

b. Combustion Characteristics: ASTM E 136.

C. Recycled Content:

1. Provide glass-fiber insulation with recycled content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

a. Provide slag-wool-fiber/rock-wool-fiber insulation with recycled content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 75 percent.

b. Provide extruded-polystyrene board insulation with recycled content so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 5 percent.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.

a. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.

b. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 FOAM-PLASTIC BOARD INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and density indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:

a. DiversiFoam Products.

b. Dow Chemical Company.

c. Owens Corning.

d. Pactiv Building Products Division.

2. Type IV, 1.60 lb/cu. ft., unless otherwise indicated.

3. R-Value: 5 per inch of thickness.

2.2 SLAG-WOOL-FIBER/ROCK-WOOL-FIBER BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:

1. Fibrex Insulations Inc.

a. Owens Corning.

b. Thermafiber.

B. Unfaced, Slag-Wool-Fiber/Rock-Wool-Fiber Blanket Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

C. Faced, Slag-Wool-Fiber/Rock-Wool-Fiber Blanket Insulation: ASTM C 665, Type III (blankets with reflective membrane facing), Class A (membrane-faced surface with a flame spread of 25 or less); Category 1 (membrane is a vapor barrier), faced with foil-scrim-kraft, foil-scrim, or foil-scrim-polyethylene vapor-retarder membrane on 1 face.

D. Where slag-wool-fiber/rock-wool-fiber blanket insulation is indicated by the following thicknesses, provide blankets in batt form with thermal resistances indicated:

1. 1-1/2 inches thick with a thermal resistance of 6 deg F x h x sq. ft./Btu at 75 deg F.

a. 3-1/2 inches (89 mm) thick with a thermal resistance of 13 deg F x h x sq. ft./Btu at 75 deg F (2.3 K x sq. m/W at 24 deg C).

b. 4 inches (101 mm) thick with a thermal resistance of 16 deg F x h x sq. ft./Btu at 75 deg F (2.8 K x sq. m/W at 24 deg C).

c. 5-1/4 inches (133 mm) thick with a thermal resistance of 19 deg F x h x sq. ft./Btu at 75 deg F (3.3 K x sq. m/W at 24 deg C).

d. 6 inches (152 mm) thick with a thermal resistance of 22 deg F x h x sq. ft./Btu at 75 deg F (3.9 K x sq. m/W at 24 deg C).

2.3 FIRESAFING

A. Firesafing: Unfaced, slag-wool-fiber/rock-wool-fiber blanket insulation as specified in this Section and accepted by manufacturer of through-penetration firestop systems and fire-resistive joint systems for use with their assemblies. Provide where indicated or where required by assembly.

2.4 AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

B. Vapor Retarders: Products specified as under-slab vapor retarders may be used in this application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.3 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.4 INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION

A. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.

1. If not otherwise indicated, extend insulation a minimum of 24 inches below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

C. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection course with joints butted. Set in adhesive according to insulation manufacturer's written instructions.

D. Protect top surface of horizontal insulation from damage during concrete work by applying protection course with joints butted.

3.5 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Seal joints between foam-plastic insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

C. Set vapor-retarder-faced units with vapor retarder to warm-in-winter side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.

1. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

D. Install mineral-fiber insulation in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.

a. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

b. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures.

c. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

E. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.

a. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.

b. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.

c. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

F. Install board insulation in curtain-wall construction where indicated on Drawings according to curtain-wall manufacturer's written instructions.

1. Retain insulation in place by metal clips and straps or integral pockets within window frames, spaced at intervals recommended in writing by insulation manufacturer to hold insulation securely in place without touching spandrel glass. Maintain cavity width of dimension indicated between insulation and glass.

a. Install insulation where it contacts perimeter fire-containment system to prevent insulation from bowing under pressure from perimeter fire-containment system.

G. Stuff glass-fiber loose-fill insulation into miscellaneous voids and cavity spaces where shown. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..

3.6 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

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 self-adhering, vapor-retarding, modified bituminous sheet air barriers.

B. Related Sections include the following:

1. Division 4 Section "Unit Masonry Assemblies" for the following:
    a. Embedded flashings.
2. Division 7 Section "Building Insulation" for foam-plastic board insulation.
3. Division 7 Section "Fluid-Applied Membrane Air Barriers."
4. Division 7 Section "Sheet Metal Flashing and Trim" for sheet metal flashings.
5. Division 7 Section "Joint Sealants" for joint-sealant materials and installation.

1.3 DEFINITIONS

A. ABAA: Air Barrier Association of America.

B. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

1.5 SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.

B. Connecticut High Performance Building Submittals:

1. Recycled Content: Provide data showing postconsumer and preconsumer recycled materials content of materials and fabricated items provided for this project, stated as a percentage of the materials included in these items or materials provided as part of the Work of this Section.
2. Regional Materials: Provide data showing materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If only a fraction

of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

C. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

1. Include details of interfaces with other materials that form part of air barrier.

2. Include details of mockups.

D. Certificates:

1. For air barriers, certifying compatibility of air barrier and accessory materials with Project materials that connect to or that come in contact with the barrier; signed by product manufacturer.

2. Certify compliance of wall assembly as a system including air barrier and accessory materials included as part of the Work of this Section with fire performance requirements of NFPA 285.

E. Qualification Data: For Applicator.

F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air barriers.

1.6 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Preinstallation Conference: Conduct conference at Project site.

1. Include installers of other construction connecting to air barrier, such as roofing, waterproofing, architectural precast concrete, masonry, joint sealants, windows, glazed curtain walls, and door frames.

2. Review air barrier requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, forecasted weather conditions, special details and sheet flashings, mockups, installation procedures, sequence of installation, testing and inspecting procedures, and protection and repairs.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier manufacturer.

B. Remove and replace liquid materials that cannot be applied within their stated shelf life.

C. Store rolls according to manufacturer's written instructions.

D. Protect stored materials from direct sunlight.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental

conditions that affect performance of air barrier. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 SELF-ADHERING SHEET AIR BARRIER

A. Modified Bituminous Sheet: 40-mil- thick, self-adhering sheet consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick, polyethylene film with release liner on adhesive side and formulated for application with primer that complies with VOC limits of authorities having jurisdiction.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Carlisle Coatings & Waterproofing; CCW-705.
   b. Grace, W. R. & Co.; Perm-A-Barrier.
   c. Henry Company; Blueskin SA.
2. Physical and Performance Properties:
   a. Membrane Air Permeance: Not to exceed 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
   b. Vapor Permeance: 0.05 perms; ASTM E 96, Water Method.
3. Provide product compatible with adjacent materials including but not limited to fluid-applied membrane air/vapor barriers and flexible flashing.

2.2 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by air barrier manufacturer for intended use and compatible with air barrier. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid waterborne primer recommended for substrate by manufacturer of air barrier material.

C. Counterflashing Strip: Modified bituminous 40-mil- thick, self-adhering sheet consisting of 32 mils of rubberized asphalt laminated to an 8-mil- thick, crosslaminated polyethylene film with release liner backing.

D. Butyl Strip: Vapor-retarding, 30- to 40-mil- thick, self adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive, with release liner backing.

E. Termination Mastic: Cold fluid-applied elastomeric liquid; trowel grade.

F. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

G. Adhesive and Tape: Air barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

H. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0250 inch thick, and Series 300 stainless-steel fasteners.

I. Sprayed Polyurethane Foam Sealant: 1- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft. density; flame spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

J. Modified Bituminous Transition Strip: Vapor-retarding, 40-mil- thick, smooth-surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick polyethylene film with release liner backing.

K. Elastomeric Flashing Sheet: ASTM D 2000, 2BC415 to 3BC620, minimum 50- to 65-mil-thick, cured sheet neoprene with manufacturer's recommended contact adhesives and lap sealant with stainless-steel termination bars and fasteners.

L. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low-modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Division 7 Section "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that concrete has cured and aged for minimum time period recommended by air barrier manufacturer.
3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
4. Verify that masonry joints are flush and completely filled with mortar.
5. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. Gaps, Cracks, and Joints: Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.

1. Install modified bituminous strips and center over treated construction and contraction joints and cracks or gaps in the substrate exceeding a width of 1/16 inch up to 1/4 inch.
2. Bridge and cover isolation joints, expansion joints, and discontinuous deck-to-wall and deck-to-deck joints subject to movement with overlapping modified bituminous strips.

3. Cover gaps 1/4 inch or wider in substrate plane with stainless-steel sheet mechanically fastened to structural framing or masonry backup construction to provide continuous support for air barrier, and form a smooth transition from one substrate plane to another.

G. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

3.3 INSTALLATION

A. Install modified bituminous sheets according to air barrier manufacturer's written instructions and according to recommendations in ASTM D 6135.

1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous air barrier sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.

B. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.

1. Install modified bituminous strips centered over vertical inside corners. Install 3/4-inch fillets of termination mastic on horizontal inside corners.

C. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations with termination mastic and according to ASTM D 6135.

D. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

E. Apply and firmly adhere modified bituminous sheets horizontally over area to receive air barrier sheets. Accurately align sheets and maintain a uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams and stagger end laps to ensure airtight installation.

1. Apply sheets in a shingled manner to shed water without interception by any exposed sheet edges.

2. Roll sheets firmly to enhance adhesion to substrate.

F. Apply continuous modified bituminous sheets over modified bituminous strips bridging substrate cracks, construction, and contraction joints.

G. CMU: Install air barrier sheet horizontally against the CMU beginning at base of wall. Align top edge of air barrier sheet immediately below protruding masonry ties or joint reinforcement or ties and firmly adhere in place.

1. Overlap horizontally adjacent sheets a minimum of 2 inches and roll seams.

2. Apply overlapping sheets with bottom edge slit to fit around masonry reinforcing or ties. Roll firmly into place.

3. Seal around masonry reinforcing or ties and penetrations with termination mastic.

4. Continue the membrane into all openings in the wall, such as doors, windows, and terminate at points to maintain an airtight barrier that will not be visible from interior.

5. Lap membrane over top of wall before truss installation to maintain continuity with interior ceiling vapor barrier and prevent the need to interleave segments between trusses.

H. Seal top of through-wall flashings to air barrier sheet with an additional 6-inch- wide, counterflashing strip.

I. Seal exposed edges of sheets at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

J. Install air barrier sheets and auxiliary materials to form a seal with adjacent construction and to maintain a continuous air barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.

2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over both substrates.

K. Connect and seal exterior wall air barrier membrane continuously to roofing membrane air barrier, concrete below-grade structures, floor-to floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings using accessory materials.

L. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply elastomeric flashing sheet so that a minimum of 3 inches of coverage is achieved over both substrates. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.

1. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6 inches o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.

M. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, doors, and miscellaneous penetrations of air barrier membrane with foam sealant.

N. At end or each working day, seal top edge of membrane to substrate with termination mastic.

O. Apply joint sealants forming part of air barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

P. Repair punctures, voids, and deficient lapped seams in air barrier. Slit and flatten fishmouths and blisters. Patch with air barrier sheet extending 6 inches beyond repaired areas in all directions.

Q. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

R. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections of air barrier materials and installation for compliance with requirements and prepare test reports.

B. Inspections: Inspections may include the following:

1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.

2. Continuous structural support of air barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed.
7. Laps in sheet materials have complied with the minimum requirements and have been shingled in the correct direction (or mastic applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Air barrier has been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

C. Remove and replace deficient air barrier components and retest as specified above.

3.5 CLEANING AND PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed to these conditions for more than 60 days.
2. Protect air barrier from contact with creosote, uncured coal-tar products, TPO, EPDM, flexible PVC membranes, and sealants not approved by air barrier manufacturer.

B. Clean spills, stains, and soiling from adjacent construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 27 13

ISSUED for BID

SECTION 07 27 26 - FLUID-APPLIED MEMBRANE AIR BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Fluid-applied membrane air barrier, vapor retarding.

B. Related Sections include the following:

1. Division 4 Section "Unit Masonry Assemblies" for embedded flashings and cavity wall insulation.
2. Division 5 Section "Cold-Formed Metal Framing" for wall sheathings, wall sheathing joint-and-penetration treatments, building paper, and building wraps.
3. Division 7 Section "Building Insulation" for foam-plastic board insulation.
4. Division 7 Section “Self-Adhering Sheet Air Barriers.”
5. Division 7 Section "Exterior Insulation and Finish Systems - Class PB" for fluid-applied, vapor retarding, water- and weather resistive barrier coating applied as part of exterior insulation and finish system.
6. Division 7 Section "Sheet Metal Flashing and Trim" for sheet metal flashings.
7. Division 7 Section "Joint Sealants" for joint-sealant materials and installation.

1.2 DEFINITIONS

A. Air Barrier Assembly: The collection of air barrier materials and auxiliary materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.3 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of air barrier.

B. Shop Drawings: Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strip, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.

1. Include details of interfaces with other materials that form part of air barrier.
2. Include details of mockups.

C. Certificates:

1. For air/vapor barriers, certifying compatibility of air barrier and accessory materials with Project materials that connect to or that come in contact with the barrier; signed by product manufacturer.
2. Certify compliance of wall assembly as a system including air barrier and accessory materials included as part of the Work of this Section with fire performance requirements of NFPA 285.

D. Qualification Data: For Applicator.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for air barriers.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: A firm experienced in applying air barrier materials similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Mockups: Before beginning installation of air barrier, build mockups of exterior wall assembly, 150 sq. ft., incorporating backup wall construction, external cladding, window, door frame and sill, insulation, and flashing to demonstrate surface preparation, crack and joint treatment, and sealing of gaps, terminations, and penetrations of air barrier membrane.

1. Coordinate construction of mockup to permit inspection by Owner's testing agency of air barrier before external insulation and cladding is installed.
2. Include junction with roofing membrane, building corner condition, and foundation wall intersection.
3. If Architect determines mockups do not comply with requirements, reconstruct mockups and apply air barrier until mockups are approved.

C. Preinstallation Conference: Conduct conference at Project site.

1. Include installers of other construction connecting to air barrier, including roofing, waterproofing, architectural precast concrete, masonry, sealants, windows, glazed curtain walls, and door frames.
2. Review air barrier requirements including surface preparation, substrate condition and pretreatment, minimum substrate curing period, forecasted weather conditions, special details and sheet flashings, mockups, installation procedures, sequence of installation, testing and inspecting procedures, and protection and repairs.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store liquid materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by air barrier manufacturer.

B. Remove and replace liquid materials that cannot be applied within their stated shelf life.

C. Store rolls according to manufacturer's written instructions.

D. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air barrier manufacturer. Protect substrates from environmental conditions that affect performance of air barrier. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 FLUID-APPLIED VAPOR-RETARDING MEMBRANE AIR BARRIER

A. Fluid-Applied, Vapor-Retarding Membrane Air Barrier: Synthetic polymer membrane.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Synthetic Polymer Membrane:

1) Grace, W. R. & Co.; Perm-A-Barrier Liquid.
2) Select first option in subparagraph below for hot and humid climate, second or third option for cold climate.
3) Henry Company; Air-Bloc 21FR.
4) Rubber Polymer Corporation, Inc.; Rub-R-Wall Airtight.

2. Physical and Performance Properties:

a. Membrane Air Permeance: Not to exceed 0.004 cfm x sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
b. Membrane Vapor Permeance: Not to exceed 0.1 perm; ASTM E 96.

2.2 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by air barrier manufacturer for intended use and compatible with air barrier membrane. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid primer recommended for substrate by manufacturer of air barrier material.

C. Counterflashing Strip: Modified bituminous, 40-mil- thick, self-adhering sheet consisting of 32 mils of rubberized asphalt laminated to an 8-mil- thick, crosslaminated polyethylene film with release liner backing.

D. Butyl Strip: Vapor-retarding, 30- to 40-mil- thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive with release liner backing.

E. Joint Reinforcing Strip: Air barrier manufacturer's glass-fiber-mesh tape.

F. Substrate Patching Membrane: Manufacturer's standard trowel-grade substrate filler.

G. Adhesive and Tape: Air barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

H. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304, 0.0250 inch thick, and Series 300 stainless-steel fasteners.

I. Sprayed Polyurethane Foam Sealant: 1- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft density; flame spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

J. Elastomeric Flashing Sheet: ASTM D 2000, 2BC415 to 3BC620, minimum 50- to 65-mil-thick, cured sheet neoprene with manufacturer's recommended contact adhesives and lap sealant with stainless-steel termination bars and fasteners.

K. Joint Sealant: ASTM C 920, single-component, neutral-curing silicone; Class 100/50 (low-modulus), Grade NS, Use NT related to exposure, and, as applicable to joint substrates indicated, Use O. Comply with Division 7 Section "Joint Sealants."

L. Termination Mastic: Air-barrier manufacturer's standard cold fluid-applied elastomeric liquid; trowel grade.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that concrete has cured and aged for minimum time period recommended by air barrier manufacturer.
3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
4. Verify that masonry joints are flush and completely filled with mortar.
5. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.

1. Prime substrate and apply a single thickness of preparation coat strip extending a minimum of 3 inches along each side of joints and cracks. Apply a double thickness of air barrier membrane and embed a joint reinforcing strip in preparation coat.

B. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and with air barrier manufacturer's written instructions. Apply first layer of fluid air barrier membrane at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air barrier membrane over joint reinforcing strip.

3.4 TRANSITION STRIP INSTALLATION

A. Install strips, transition strips, and auxiliary materials according to air barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install transition strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over both substrates.

B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by air barrier sheet in same day. Reprime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

C. Connect and seal exterior wall air barrier membrane continuously to roofing membrane air barrier, concrete below-grade structures, floor-to floor construction, exterior glazing and

window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

E. Apply joint sealants forming part of air barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Wall Openings: Prime concealed perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply transition strip so that a minimum of 3 inches of coverage is achieved over both substrates. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.

1. Adhesive-Coated Transition Strip: Roll firmly to enhance adhesion.
2. Elastomeric Flashing Sheet: Apply adhesive to wall, frame, and flashing sheet. Install flashing sheet and termination bars, fastened at 6 inches o.c. Apply lap sealant over exposed edges and on cavity side of flashing sheet.
3. Preformed Silicone-Sealant Extrusion: Set in full bed of silicone sealant applied to walls, frame, and air-barrier material.

G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air barrier membrane with foam sealant.

H. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

I. Seal top of through-wall flashings to air barrier with an additional 6-inch- wide, counterflashing strip.

J. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

K. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.5 AIR BARRIER MEMBRANE INSTALLATION

A. General: Apply fluid air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions. Apply fluid air-barrier material within manufacturer's recommended application temperature ranges.

1. Apply primer to substrates at required rate and allow it to dry.
2. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.
3. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

B. Membrane Air Barriers: Apply a continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier membrane in full contact around protrusions such as masonry ties.

1. Vapor-Retarding Membrane Air Barrier: Total dry film thickness as recommended in writing by manufacturer to meet performance requirements, but not less than 40-mil (1.0-mm) dry film thickness, applied in one or more equal coats.

C. Apply strip and transition strip over cured air-barrier material overlapping 3 inches (75 mm) onto each surface according to air-barrier manufacturer's written instructions.

D. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

E. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Inspections: Air barrier materials and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed, if applicable.
7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Strips and transition strips have been firmly adhered to substrate.
10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (membrane and sealants) have complied with requirements for cleanliness, preparation and priming of surfaces, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

C. Tests: As determined by Owner's testing agency from among the following tests:

1. Qualitative Air-Leakage Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, smoke pencil with pressurization or depressurization or ASTM E 1186, chamber pressurization or depressurization with smoke tracers.

2. Quantitative Air-Leakage Testing: Air-barrier assemblies will be tested for air leakage according to ASTM E 783.
3. Adhesion Testing: Air-barrier assemblies will be tested for minimum air-barrier adhesion of 30 lbf/sq. in. according to ASTM D 4541 for each 600 sq. ft. of installed air barrier or part thereof.

D. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.7 CLEANING AND PROTECTION

A. Protect air barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. Remove and replace air barrier exposed for more than 30 days.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 07 27 26

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Asphalt roofing shingles.

B. Leak barrier and roof deck protection.

C. Metal flashing associated with shingle roofing.

D. Attic ventilation.

1.2 RELATED SECTIONS

A. Section 06100 - Rough Carpentry: Framing, wood decking, and roof sheathing.

B. Section 07620 - Flashing and Sheet Metal: Sheet metal flashing not associated with shingle roofing; gutters and downspouts.

1.3 REFERENCES American Society for Testing and Materials (ASTM) - Annual Book of ASTM Standards

B. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

C. ASTC438-1011-R1 – New Acceptance Criteria for Alternative Asphalt Roofing Shingles

D. Underwriters Laboratories (UL) - Roofing Systems and Materials Guide (TFWZ.R21)

E. UL 790 - Tests for Fire Resistance of Roof Covering Materials.

F. UL 997 - Wind Resistance of Prepared Roof Covering Materials.

G. Asphalt Roofing Manufacturers Association (ARMA)

H. Sheet Metal and Air Conditioning Contractors National Association, 1nc. (SMACNA) - Architectural Sheet Metal Manual.

I. National Roofing Contractors Association (NRCA)

J. American Society of Civil Engineers (ASCE).

1.4 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D1079 and the glossary of the National Roofing Contractors Association (NRCA) Roofing and Waterproofing Manual for definitions of roofing terms related to this section.

1.5 SUBMITTALS

A. Submit copies of product data sheets, detail drawings and samples for each type of roofing product.Indicate relationship of submitted product to warranty requirements.

B. Submit for selection, range of available colors in a size format large enough to demonstrate the range of variations within color group.

C. Submit style, color, and configuration of shingles for other than Basis of Design

product.

D. Submit Installer's certifications and authorizations to perform work that will deliver the maximum available manufacturer warranty.

E. Submit specimen form of warranty indicating criterea required to achieve maximum available benefit of warranty coverage.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide all primary roofing products, including shingles, underlayment, leak barrier, and ventilation, by a single manufacturer.

B. Installer Qualifications: Installer must be approved by manufacturer for installation yielding maximum available warranty for all products within scope of warranty.

1.7 REGULATORY REQUIREMENTS

A. Provide a roofing system listed as an Underwriters Laboratories (UL) Class A fire classification.

B. The requirements of the Connecticut State Building Code will be enforced throughout this installation.

1.8 PREINSTALLATION MEETING

A. General: Schedule a pre-installation meeting coinciding with a regularly scheduled Job Meeting prior to scheduled installation.

B. Attendees: Meeting to be called for by manufacturer's certified contractor. Meeting's mandatory attendees shall include the certified contractor, the manufacturer's representative, the owner's representative, architect, and the superintendent .

C. Topics: Certified contractor and manufacturer's representative shall review all pertinent requirements for the project, including but not limited to, scheduling, weather considerations, project duration, and requirements for the specified warranty.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store all products in manufacturer's unopened, labeled packaging until they are ready for installation.

B. Store products in a covered, ventilated area, at temperature not more than 110 degrees F (43 degrees C); do not store near steam pipes, radiators, or in direct sunlight.

C. Store bundles on a flat, properly drained surface. Maximum stacking height shall not exceed manufacturer's recommendations. Store all rolls on end.

D. Store and dispose of solvent-based materials in accordance with all federal, state and local regulations.

1.10 WEATHER CONDITIONS

A. Proceed with work only when existing and forecasted weather conditions will permit work to be performed in accordance with manufacturer's recommendations

1.11 WARRANTY Provide to the benefit of the Owner, a manufacturer's comprehensive roof system Warranty.

B. Duration for shingles: 40 years, covering ownership by the State of Connecticut.

C. Manufacturing defects: 100% coverage for materials for 20 years non-prorated, then 20% thereafter for all shingles.

D. Against algae discoloration for 10 years

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis of Design Product:Camelot II style shingle with appurtenant system products manufactured by GAF®, 1 Campus Drive, Parsippany, NJ 07054. Tel: 1-973-628-3000.

2.2 SHINGLES

A. Granule surfaced, self-sealing premium asphalt shingle with a woven fiberglass felt reinforced core with integral surface protection from discoloration caused by blue-green algae.

B. Tab and profile configuration for products other than Basis of Design shall be as selected by the Architect consistent with the strength of the warranty offered.

C. Shingle system shall be UL 790 Class A rated with UL 997 Wind Resistance Label; ASTM D 7158, Class H; ASTM D 3161, Class F, Type 1; ASTM D 3018, Type 1; ASTM D 3462; AC438 compliant; CSA 123.5-98. Evidence of further compliance may include approval by the Texas Dept of Insurance and ICC Reports.

D. Color: As selected from manufacturers' full range

2.3 RIDGE SHINGLES

A. Self sealing ridge cap shingle matching the color and manufacturing methods of selected roof shingle sized to course into shingle field and cover rige venting.

2.4 STARTER STRIP

A. Self sealing starter shingle designed by shingle manufacturer for premium roof shingles.

2.5 LEAK BARRIER

A. Self-adhering, self-sealing, min 60mil bituminous leak barrier surfaced with fine, skid-resistant granules. Evidence of compliance shall include approvals by: UL, Dade County, ICC, State of Florida and Texas Department of Insurance.

2.6 SHINGLE UNDERLAYMENT

A. Premium, water repellant, breather type non-asphaltic underlayment of UV stabilized polypropylene construction.

B. Meet or exceed ASTM D226 and D4869.

C. Evidence of compliance shall include approval by Dade Country, Florida Building Code, and ICC.

2.7 ROOFING CEMENT

A. Asphalt Plastic Roofing Cement meeting the requirements of ASTM D 4586, Type I or II.

2.8 ROOF ACCESSORIES

A. Flashing boots, vent collars, and similar devices intended to maintain waterproof integrity between the roof system and construction penetrating the roof system shall be products and devices manufactured or recommended by the roofing system manufacturer to achieve the intended maximum available warranty.

2.9 ATTIC VENTILATION

A. Ridge Vents

.1 Flexible rigid plastic ridge ventilator designed to allow the passage of hot air from attic/truss space, while resisting snow infiltration, for use in conjunction with eave/soffit ventilation products. Provide 12.5 sq inches Net Free Ventilation Area per lineal foot.

B. Fascia and Soffit/Under Eave Vents

.1 Continuous, screened aluminum soffit vent.

2.10 NAILS

A. Standard round wire, zinc-coated steel or aluminum; 10 to 12 gauge, smooth, barbed or deformed shank, with heads 3/8 inch to 7/16 inch in diameter. Length must be sufficient to penetrate into solid wood at least 3/4 inch or through plywood or oriented strand board by at least 1/8 inch

2.11 METAL FLASHING

A. 0.032-inch aluminum sheet, complying with ASTM B 209.

B. Where exposed to view, metal flashing shall be Kynar coated with color approved color.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not begin installation until the roof deck has been properly prepared.

B. If roof deck preparation is the responsibility of another installer, notify the Owner's Representative and Contractor of unsatisfactory preparation before proceeding.

3.2 PREPARATION OF SUBSTRATE

A. Clean deck surfaces thoroughly prior to installation of eaves protection membrane

and underlayment.

B. At areas that receive eaves protection membrane, fill knotholes and cracks with latex filler.

3.3 INSTALLATION OF UNDERLAYMENTS

A. General:

.1 Install using methods recommended by the manufacturer specific to the warranty, in accordance with local building codes. When local codes and application instructions are in conflict, the more stringent requirements shall take precedence.

B. Eaves:

.1 Install eaves edge metal flashing tight with fascia boards; lap joints 2 inches and seal with plastic cement or high quality urethane sealant; nail at the top of the flange.

.2 Install leak barrier up the slope from eaves edge a full 36 inches or to at least 24 inches beyond the interior “warm wall”. Lap ends 6 inches and bond.

C. Ridges:

.1 Install leak barrier along entire lengths. Position the leak barrier so that the ridge ventilation slots will not be covered.

D. Roof Deck Protection:

.1 Install one layer of roof deck protection over the entire area not protected by leak barrier at the eaves. Install sheets horizontally so water sheds and nail in place.

.2 Lap horizontal edges at least 4 inches and at least 2 inches over eaves protection membrane.

.3 Lap ends at least 4 inches. Stagger end laps of each layer at least 36 inches

.4 Install over a clean, dry deck.

.5 For exposure to rain or snow, overlap 12” at end laps.

.6 For side and end laps: fasten 6”o.c.

.7 For middle of the roll: fasten 12” o.c. For exposure to rail or snow, completely cover all side laps, end laps and fasteners with tape.

.8 For long term exposure submit manufacturer’s installation instructions for side lap detail.

.9 Apply tape over all fasteners at the center of the roll to prevent rain or snow from entering at the fasteners.

E. Penetrations:

.1 Vent pipes: Install a 24 inch square piece of eaves protection membrane lapping over roof deck underlayment; seal tightly to pipe.

F. Rake Edges: Install metal edge flashing over eaves protection membrane and roof deck underlayment; set tight to rake boards; lap joints at least 2 inches and seal with plastic cement; secure with nails.

3.4 INSTALLATION OF STARTER SHINGLES

A. General:

.1 Install in accordance with manufacturer's instructions and local building codes. When local codes and application instructions are in conflict, the more stringent requirements shall take precedence.

.2 Refer to application instructions for the selected starter strip shingles.

B. Placement and Nailing:

.1 Install starter strip containing sealant or cement shingles to underlayment and each other in a 4" width of asphalt plastic roof cement.

.2 Place starter strip shingles 1/2" over eave and rake edges to provide drip edge.

.3 Nail approximately 1-1/2" – 3" (38 – 76mm) above the butt edge of the shingle.

.4 Overlap rake starter course at eave edge starter strip minimum 3".

3.5 INSTALLATION OF SHINGLES

A. General:

.1 Install in accordance with manufacturer’s instructions and local building codes. When local codes and application instructions are in conflict, the more stringent requirements shall take precedence.

.2 Handle bundles to avoid breakage and edge damage. Separate shingles carefully. Do not "break" bundles over ridge. Taking extra precautions in temperatures below 40 degrees F.

.3 Handle carefully in hot weather to avoid scuffing the mineral surfacing, or damaging the shingle edges.

B. Placement and Nailing:

.1 Secure with 6 nails per shingle per manufacturer’s application instructions and local codes.

.2 Placement of nails varies based on the type of shingle specified. Consult the application instructions for the specified shingle for details.

.3 Drive nails flush with the shingle surface. Do not overdrive or under drive the nails.

.4 Shingle offset varies based on the type of shingle specified. Consult the application instructions for the specified shingle for details.

C. Penetrations

.1 All penetrations are to be flashed with devices and techniques to satisfy manufacturer's maximum warranty requirements.

3.6 INSTALLATION OF ATTIC VENTILATION

A. Ridge / Soffit ventilation

.1 Install ridge vent along the entire length of ridges:

.2 Cut continuous vent slots through the sheathing, stopping 6 inches from each end of the ridge.

.3 On roofs without ridge board, make a slot 1 inch wide, on either side of the peak (2 inch overall).

.4 Install ridge vent material along the full length of the ridge, including uncut areas.

.5 Butt ends of ridge vent material and join using roofing cement.

.6 Install eaves vents in sufficient quantity to equal or exceed the ridge vent area.

3.7 PROTECTION

A. Protect installed products from foot traffic until completion of the project.

B. Protect all roof areas not completed by the end of the workday.

END OF SECTION

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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 sheet metal flashing and trim:

1. Manufactured through-wall flashing.
2. Formed roof drainage system.

B. Related Sections include the following:

1. Division 1 Section “Warranties and Bonds – CMR” for warranty requirements applicable to the Work of this Section.
2. Division 4 Section "Unit Masonry Assemblies" for installing through-wall flashing and other sheet metal flashing and trim.
3. Division 6 Section “Miscellaneous Carpentry” for wood nailers, curbs, and blocking.
4. Division 7 Section "Joint Sealants" for field-applied sheet metal flashing and trim sealants.

1.3 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight with no fastener disengagement.

B. Sheet Metal Standard for Flashing and Trim: Comply with the following for requirements for dimensions and profiles shown unless more stringent requirements are indicated.

1. NRCA's "The NRCA Roofing Manual."
2. SMACNA's "Architectural Sheet Metal Manual."
3. Copper Standard: CDA's "Copper in Architecture Handbook," for profiles and techniques applicable to sheet metal work not restricted to copper.

C. FM Approvals Listing: Manufacture and install copings and roof edge flashings that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-75. Identify materials with name of fabricator and design approved by FM Approvals.

D. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

E. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Connecticut High Performance Building Submittals:

1. Recycled Content: Provide data showing postconsumer and preconsumer recycled materials content of materials and fabricated items provided for this project, stated as a percentage of the materials included in these items or materials provided as part of the Work of this Section.

2. Regional Materials: Provide data showing materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

C. Shop Drawings:

1. As part of the Base Bid prepare Shop Drawings explicitly for this Project showing wall assemblies, wall sections, roof assemblies, and details specific to this Project. Generic details and shop drawings not specifically drawn for this Project will be rejected.

2. Shop Drawings and details shall be comprehensive and include conditions including but not limited to termination of roof at inside and outside building corners, changes in roof elevations, terminations of parapets at walls, terminations of roof edges at walls, conditions at roof expansion joints intersecting with expansion joints in walls, and the like. Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:

a. Identify material, thickness, weight, and finish for each item and location in Project.

b. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.

c. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.

d. Details for expansion and contraction.

e. Details of expansion-joint covers, including showing direction of expansion and contraction.

f. Draw details at scale not less than 3” = 1’-0”.

D. Samples for Initial Selection: For each type of sheet metal flashing and trim indicated with factory-applied color finishes.

1. Include similar Samples of trim and accessories involving color selection.

E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches long. Include fasteners, cleats, clips, closures, and other attachments. Submit three (3) samples showing the full range of variations expected.

2. Trim: 12 inches long. Submit three (3) samples showing the full range of variations expected. Include fasteners and other exposed accessories.

3. Accessories: Full-size Sample.

1.5 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.

2. Review methods and procedures related to sheet metal flashing and trim.

3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.

4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.7 COORDINATION

A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Zinc-Tin Alloy-Coated Copper Sheet: ASTM B 370, cold-rolled copper sheet, H00 temper, coated on both sides with a zinc-tin alloy (50 percent zinc, 50 percent tin), and with factory-applied gray preweathering, color to match finish of zinc alloy sheet furnished under requirements of section 074213.13 “Zinc-Alloy Metal Wall Panels.”

1. Weight (Thickness): 20-oz./sq. ft. uncoated weight, with 0.787-mil coating thickness applied to each side.

2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.

b. Blind Fasteners: Stainless-steel rivets.

2. Fasteners for Zinc-Tin Alloy-Coated Copper Sheet: Copper, hardware bronze or Series 300 stainless steel.

a. Nails for Copper Sheet: Copper or hardware bronze, 0.109 inch minimum and not less than 7/8 inch long, barbed with large head.

C. Solder for Zinc-Tin Alloy-Coated Copper: ASTM B 32, Grade Sb5: 94 percent tin, 4.5-5.5 percent antimony and lead content not to exceed 0.05 percent.

D. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

E. Elastomeric Sealant: ASTM C 920, elastomeric polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.

G. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers whose products may be incorporated in the Work of this Section include, but are not limited to the following:

a. Karnak Corp.

b. Euclid Chemical Co.

c. Henry Co.

d. W R Meadows, Inc.

H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.3 MANUFACTURED SHEET METAL FLASHING AND TRIM

A. Through-Wall Ribbed Sheet Metal Flashing: Manufacture through-wall sheet metal flashing for embedment in masonry with ribs at 3-inch intervals along length of flashing to provide an integral

mortar bond. Manufacture through-wall flashing with snaplock receiver on exterior face to receive counterflashing where indicated.

1. Zinc-Tin Alloy Coated Copper: 10-oz / sq ft weight (0.0135 inch thickness) for fully concealed flashing; 16-oz / sq ft weight (0.0216 inch thickness) elsewhere.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
3. Obtain field measurements for accurate fit before shop fabrication.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

C. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

D. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.

E. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" and FMG Loss Prevention Data Sheet 1-49 for application but not less than thickness of metal being secured

2.5 GUTTERS AND DOWNSPOUTS

A. Form gutters and downspouts to indicated profiles using minimum .032” Kynar coated aluminum coil stock.

1. Color shall be selected from “custom” palette.
2. Make gutter runs continuous to fabricated end-caps.
3. Attach gutters with formed-section brackets that resist gutter spread and deformation.
4. Hang gutters with leading edge 1” below projected slope of roof, pitched 1/16”/2lf to downspout.
5. Form downspout-gutter joint as a free-flowing sump. Do not allow drop tube to dam flow in gutter.

6. Fasten downspout fittings with stainless steel self-drill sheet metal screws

2.6 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- long, but not exceeding 12 foot long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings. Form with 2-inch- high end dams.

1. Fabricate from the following material:

a. Zinc-Tin Alloy-Coated Copper: 16 oz./sq. ft..

B. Openings Flashing in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch- high end dams.

1. Fabricate from the following material:

a. Zinc-Tin Alloy-Coated Copper: 16 oz./sq. ft..

C. Wall Expansion-Joint Cover:

1. Fabricate from the following material:

a. Zinc-Tin Alloy-Coated Copper: 16 oz./sq. ft..

2.7 MISCELLANEOUS SHEET METAL FABRICATIONS

A. Equipment Support Flashing:

1. Fabricate from the following material:

a. Zinc-Tin Alloy-Coated Copper: 16 oz./sq. ft..

2.8 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.

1. Verify compliance with requirements for installation tolerances of substrates.

2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.

2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

3. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

5. Install sealant tape where indicated.

6. Torch cutting of sheet metal flashing and trim is not permitted.

7. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.

1. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.

2. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.

C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.

E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

1. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.

G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

1. Copper Use copper or stainless-steel fasteners.

2. Aluminum – Use stainless steel fasteners

H. Seal joints with sealant as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.

2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

I. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches except where pretinned surface would show in finished Work.

1. Pretinning is not required for zinc-tin ally-coated copper.

2. Zinc-Tin Alloy-Coated Copper Soldering: Chemically or mechanically clean edges of sheets as recommended by sheet manufacturer before soldering.

3. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.

3.3 ROOF FLASHING INSTALLATION

A. General: Install sheet metal roof flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.

1. Interlock bottom edge of roof edge flashing with continuous cleats anchored to substrate at 16-inch centers.

C. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant.

1. Secure in a waterproof manner by means of interlocking folded seam or blind rivets and sealant.

E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:

1. Turn flashing down inside vent piping, being careful not to block vent piping with flashing.

2. Seal with sealant and clamp flashing to pipes penetrating roof except for flashing on vent piping.

3.4 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Through-Wall Flashing: Installation of through-wall flashing is specified in Division 4 Section "Unit Masonry Assemblies."

3.5 MISCELLANEOUS FLASHING INSTALLATION

A. Overhead-Piping Safety Pans: Suspend pans from pipe and install drain line to plumbing waste or drain line.

B. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with sealant to equipment support member.

3.6 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials.

C. Clean off excess solder and sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 62 00

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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 joint sealants for the applications indicated in the Joint-Sealant Schedule at the end of Part 3.

B. Related Sections include the following:

1. Division 1 Section “Warranties and Bonds” for warranty requirements applicable to the Work of this Section.

2. Division 32 Section "Concrete Paving" for sealing joints in pavements, walkways, and curbing.

1.3 PERFORMANCE REQUIREMENTS

A. Provide durable elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.4 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

1. Include manufacturer’s printed product data for sealants used on the interior of the building showing VOC content of each product used. Indicate VOC content in g/L calculated according to 40 CFR 59, Subpart D (EPA method 24)

B. Connecticut High Performance Building Submittals:

1. Regional Materials: Provide data showing materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

2. VOC Content: For adhesives, including printed statement of VOC content.

C. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

D. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

E. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.

F. Qualification Data: For Installer.

G. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

H. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Mockups: Build mockups incorporating sealant joints, as follows, to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution:

1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.

2. When joint substrates are wet.

3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: As specified by Section 017830 “Warranties and Bonds.”

B. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: As specified by Section 017830 “Warranties and Bonds.”

C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:

1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.

2. Disintegration of joint substrates from natural causes exceeding design specifications.

3. Mechanical damage caused by individuals, tools, or other outside agents.

4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range of colors including standard, premium, and custom colors.

C. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Immersion in Liquids. Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247 and qualify for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.

D. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

E. Uses: Sealants shall conform to requirements of ASTM C 920 for uses as follows:

1. M: Sealant for joints in Portland cement mortar.
2. G: Sealant for joints in clear, uncoated float glass.
3. A: Sealant for joints in clear anodized aluminum.
4. O: Sealant for use in joints in substrates other than M, G and A, including but not limited to the following:

a. Coated glass
b. Galvanized steel
c. Brick
d. Limestone
e. Concrete
f. Wood
g. Direct Applied finish systems
h. Aluminum coated with a high-performance coating.

5. NT: Sealant for use in joints in nontraffic areas.
6. T: Sealant for use in joints subject to vehicular and pedestrian traffic.
7. I: Sealant for use in joints which are continuously immersed in liquid.

F. Single-Component Neutral-Curing Low-Modulus Silicone Sealant ES-1:

1. Products:
   a. GE Silicones; SilPruf SCS2000.
   b. Pecora Corporation; 864.
   c. Polymeric Systems Inc.; PSI-641.
   d. Sonneborn, Division of ChemRex Inc.; Omniseal.
   e. Tremco; Spectrem 3.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 50.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and O.
6. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.

G. Single-Component Neutral-Curing Medium-Modulus Silicone Sealant ES-2:

1. Products:
   a. Dow Corning Corporation; 791.
   b. Dow Corning Corporation; 795
   c. GE Silicones; SilPruf NB SCS9000.
   d. GE Silicones; UltraPruf II SCS2900.
   e. Pecora Corporation; 865.
   f. Pecora Corporation; 895.
   g. Pecora Corporation; 898.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 50.

4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and O.
6. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.

H. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant ES-3:

1. Products:
   a. Pecora Corporation; 898NST.
   b. Sika Corporation, Inc.: Sikasil C.
   c. DAP Products, Inc.; DAP Silicone Plus Premium Silicone Rubber Kitchen and Bath Sealant.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and O.

I. Single-Component Nonsag Urethane Sealant ES-4:

1. Products:
   a. Sika Corporation, Inc.; Sikaflex - 1a.
   b. Sonneborn, Division of ChemRex Inc.; Ultra.
   c. Sonneborn, Division of ChemRex Inc.; NP 1.
   d. Tremco; Vulkem 116.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and O.

J. Single-Component Pourable Urethane Sealant ES-5:

1. Products:
   a. Sika Corporation, Inc.; Sikaflex - 1CSL.
   b. Sonneborn, Division of ChemRex Inc.; SL 1.
   c. Tremco; Vulkem Nova 300 SSL.
2. Type and Grade: S (single component) and P (pourable).
3. Class: 25.
4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
5. Uses Related to Joint Substrates: M, G, A, and O.

2.4 LATEX JOINT SEALANTS

A. Latex Sealant LS-1: Comply with ASTM C 834, Type P, Grade NF.

1. Products:
    a. Bostik Findley; Chem-Calk 600.
    b. Pecora Corporation; AC-20+.
    c. Schnee-Morehead, Inc.; SM 8200.
    d. Sonneborn, Division of ChemRex Inc.; Sonolac.
    e. Tremco; Tremflex 834.

2.5 PREFORMED JOINT SEALANTS

A. Preformed Expanding Foam Sealant PS-1: Manufacturer's standard preformed, compressed self-expanding foam sealant with elastomeric exposed face for exterior joints in walls, produced in roll or stick form to self-expand and fill joints indicated, coated on one side with pressure-sesitive adhesive; develops watertight and airtight seal when compressed to the degree specified by manufacturer for exterior joints on walls.

1. Basis-of-Design Product: Emseal Joint Systems, Ltd; Seismic Colorseal or a comparable product of one of the following:
    a. Williams Products; Everlastic Wide Joint Seal.
    b. MM Systems; Colorjoint ESS.
    c. Schul International Co.; Seismic Sealtite.
2. Properties: Permanently elastic, mildew resistant, nonmigratory, nonstaining, and compatible with joint substrates and other joint sealants.
    a. Density: Manufacturer's standard.
    b. Movement Capability: +/- 50 percent.
    c. Type of Movement Capability: Expansion and contraction.
    d. Maximum Joint Width: As indicated.
    e. Nominal Joint Width: As indicated.
    f. Minimum Joint Width: As indicated.
    g. Movement Capability: +/-50%.
    h. Type of Movement Capability: Expansion and contraction.
    i. Cyclic-Movement-Test-Response Characteristics: No evidence of visual fatigue, inability to cycle between designated joint widths, or other types of failure as determined by testing products identical to those indicated per ASTM E 1399 including Appendix X3.
    j. Compression Seal Material: Compressible polyurethane foam.
    k. Elastomeric Face Material: Silicone.
    l. Color: Selected by Architect from manufacturer's full range of colors including standard, premium, and custom colors.

2.6 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), O (open-cell material), B (bicellular material with a surface skin), or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

a. Concrete.

b. Masonry.

3. Remove laitance and form-release agents from concrete.

4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

a. Metal.

b. Glass.

c. Porcelain enamel.

d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.

2. Do not stretch, twist, puncture, or tear sealant backings.

3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.

2. Completely fill recesses in each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

H. Installation of Preformed Expanding Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed elastomeric sealant joints as follows:

a. Perform 10 tests for the first 1000 feet of joint length for each type of elastomeric sealant and joint substrate.

b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, Method B, Exposed Surface Finish Hand Pull Tab or Method C, Field-Applied Sealant Joint Hand Pull Flap in Appendix X1 in ASTM C 1193, as appropriate for type of joint-sealant application indicated.

a. For joints with dissimilar substrates, verify adhesion to each substrate separately; do this by extending cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field-adhesion-test log.

4. Inspect tested joints and report on the following:

a. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.

b. Whether sealants filled joint cavities and are free of voids.

c. Whether sealant dimensions and configurations comply with specified requirements.

5. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.

6. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application JS-1:

1. Exterior vertical control and expansion joints in unit masonry.

2. Exterior vertical joints between masonry, metals, plant-precast architectural concrete units and unit masonry.

a. Joint Sealant: Single-component neutral-curing silicone medium-modulus sealant ES-2

b. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors including standard, premium, and custom colors.

B. Joint-Sealant Application JS-2:

1. Mildew-resistant interior joints in vertical surfaces and horizontal non-traffic surfaces:

a. Interior joints between plumbing fixtures and adjoining walls, floors, and counters.

b. Interior joints between backsplashes and walls, and between fixtures, countertops, and walls.

c. Control and expansion joints where indicated.

d. Other joints indicated.

2. Sealant:

a. Joint Sealant: Single-component mildew-resistant neutral -curing silicone sealant ES-3.

b. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors including standard, premium, and custom colors.

C. Joint-Sealant Application JS-3:

1. Vertical control and expansion joints on exposed interior surfaces of exterior walls.

2. Interior perimeter joints of exterior openings.

a. Joint Sealant: Single-component nonsag urethane sealant ES-4

b. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors including standard, premium, and custom colors.

D. Joint-Sealant Application JS-5:

1. Vertical joints on exposed surfaces of interior unit masonry walls

2. Perimeter joints between interior wall surfaces and frames of interior doors, windows and hollow metal frames.

a. Joint Sealant: Latex sealant LS-1.

b. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors including standard, premium, and custom colors.

END OF SECTION 07 92 00

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SCHEDULES FOR OPENINGS

● NEW WORK

NHR NO HARDWARE REQUIRED

DOOR												FRAME							FIRE RATING			HARDWARE - SEE SPECIFICATIONS											
										SEE DWG				SEE DETAIL'S ON DWG.								FIRE CODE			DISABLED REQUIREMENTS								
OPENING NUMBER	SHEET NUMBER	SINGLE DOOR LEAF	DOUBLE DOOR LEAF	ACTIVE LEAF	ACTIVE LEAF (PRH & PP Hardware)	IN - ACTIVE LEAF	HEIGHT	THICKNESS	HANDING	DOOR MATERIAL	DOOR TYPE	FRAME MATERIAL	FRAME TYPE	HEAD DETAIL	JAMB DETAIL	SILL / THRESHOLD DETAIL	DIM. "W"	SOUND DOOR AND GASKETING	U.L. RATING (IN MINUTES)	GASKETS AND SMOKE SEALS		PANIC RELEASE HARDWARE	POSITIVE LATCHING	AUTOMATIC CLOSING	ELECT. MAG. DOOR RELEASE	PUSH / PULL (Interior Oenpings)	"U" HANDLE / LEVER HANDLE	MOP, KICK, & ARMOR PLATES	TACTILE WARNING	ACCESSIBLE THRESHOLD	ELECTRICAL / SECURITY	HARDWARE SET NO.	REMARKS / NOTES
E101	A1. 1	●		3'- 0"			7'- 0"	1-3/4"	RHR	HM	D-1	HM	F-1	H11	J11	S11	6"						●	●			●	●		●	●	201	CL11, E1, SW1, WRC
E101A	A1. 1	●		12'- 0"			4'- 8"	1-1/2"	COILING	COILING				H10	J10	S10	0"						●									NHR	E1, OH COILING DOOR, NHR, WRC
E102	A1. 1	●		3'- 0"			7'- 0"	1 3/4"	RHR	HM	D-1	HM	F-1A	H11	J11	S11	6"						●	●			●	●		●	●	061	CL11, E1, SW1, WRC
E103	A1. 1	●		3'- 0"			7'- 0"	1 3/4"	LHR	HM	D-1	HM	F-1A	H11	J11	S11	6"						●	●			●	●		●	●	061	CL11, E1, SW1, WRC
E104	A1. 1		●	3'- 0"	3'- 0"		7'- 0"	1 3/4"	RHR-ACT	HM	D-1	HM	F-1A	H11	J11	S11	6"						●	●			●	●		●	●	067	DS2, E1, SW1, WRC
E105	A1. 1	●		3'- 0"			7'- 0"	1 3/4"	RHR	HM	D-1	HM	F-1A	H11	J11	S11	6"						●	●			●	●		●	●	051	AC, ECTU06.3, E1, E2, CL11, SW1, WRC
E106	A1. 1	●		3'- 0"			7'- 0"	1 3/4"	RHR	HM	D-1	HM	F-1A	H11	J11	S11	6"						●	●			●	●		●	●	051	AC, ECTU06.3, E1, E2, CL11, SW1, WRC
E107	A1. 1	●		8'- 0"			8'- 0"	1 1/2"	COILING	--	--	--	--	H10	J10	STL ST C	0"													●	●	NHR	E1, OH COILING DOOR, NHR, WRC
E108	A1. 1	●		3'- 0"			7'- 0"	1-3/4"	RHR	HM	D-1	HM	F-1	H11	J11	S11	6"						●	●			●	●		●	●	401	CL11, E1, SW1, WRC
F100	B1-A1.	●		3'- 0"			7'- 0"	1-3/4"	RHR	HM	D-1	HM	F-1A	H11	J11	S11	6"						●	●			●	●		●	●	201	CL11, E1, SW1, WRC
F100A	B1-A1.	●		8'- 8"			4'- 8"	1-1/2"	COILING	COILING				H10	J10	S10	0"						●									NHR	E1, OH COILING DOOR, NHR, WRC
F101	B1-A1.	●		3'- 0"			7'- 0"	1 3/4"	RHR	HM	D-1	HM	F-1A	H11	J11	S11	6"						●	●			●	●		●	●	062	CL11, E1, SW1, WRC
F102	B1-A1.	●		3'- 0"			7'- 0"	1 3/4"	LHR	HM	D-1	HM	F-1A	H11	J11	S11	6"						●	●			●	●		●	●	062	CL11, E1, SW1, WRC
F103	B1-A1.	●		3'- 0"			7'- 0"	1-3/4"	LHR	HM	D-1	HM	F-1A	H11	J11	S11	6"						●	●			●	●		●	●	401	CL11, E1, SW1, WRC
F103A	B1-A1.	●		8'- 0"			8'- 0"	1-1/2"	COILING					H10	J10	S10	0"						●									NHR	E1, OH COILING DOOR, NHR, WRC
F104	B1-A1.	●		3'- 0"			7'- 0"	1-3/4"	RHR	HM	D-1	HM	F-1A	H11	J11	S11	6"						●	●			●	●		●	●	401	CL11, E1, SW1, WRC

SCHEDULE GENERAL NOTES

. GENERAL CONTRACTOR:

GENERAL CONTRACTOR / HARDWARE SUPPLIER:
Shall coordinate an inspection, with all manufacturer's representatives to confirm that all hardware has been installed and adjusted properly;
See "Specification Section - 08 71 00 - 3.2 - INSTALLATION

HARDWARE SUPPLIER:
Must employ an experienced Architectural Hardware Consultant (AHC) who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.

CONFLICTS between the SPECIFIED DOOR HARDWARE and the DOORS / FRAMES must be brought to the attention of the ARCHITECT prior to submitting HARDWARE SUBMITTAL to the ARCHITECT.

ISSUED for BID

HARDWARE SUPPLIER must schedule a pre - installation meeting to instruct installers on proper installation and adjustment of the Locks, Exit Devices, and Closers. A manufacturers' representative of each major hardware category shall be present to complete the instructions, and then certify to the Architect that the door hardware installer has been trained in the proper installation procedures and is certified to install the finish hardware.

ISSUED for BID

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. Steel doors, galvannealed.
2. Welded steel door frames, galvannealed.

B. Related Sections include the following:

1. Division 4 Section "Unit Masonry Assemblies" for installing anchors and grouting frames in masonry construction.
2. Division 8 Section "Door Hardware" for door hardware and weather stripping.
3. Division 9 Section "Painting" for field painting hollow metal doors and frames.
4. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.

1.3 DEFINITIONS

A. Steel Sheet Thicknesses: Thickness dimensions, including those referenced in ANSI A250.8, are minimums as defined in referenced ASTM standards for both uncoated steel sheet and the uncoated base metal of metallic-coated steel sheets.

1.4 SUBMITTALS

A. Product Data: For each type of door and frame indicated, include door designation, type, level and model, material description, core description, construction details, label compliance, sound and fire-resistance ratings, temperature-rise ratings and finishes.

B. Shop Drawings: Show the following:

1. Indicate location, size and hand of each door.
2. Elevations of each door and frame design.
3. Details of doors including vertical and horizontal edge details and metal thicknesses.
4. Frame details for each frame type including dimensioned profiles.
5. Details and locations of reinforcement and preparations for hardware.
6. Details of each different wall opening condition.
7. Details of anchorages, accessories, joints, and connections.
8. Details of conduit and preparations for power, signal, and control systems.

C. Door Schedule: Use same reference designations indicated on Drawings in preparing schedule for doors and frames.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

B. Steel Door and Frame Standard: Comply with ANSI A 250.8, unless more stringent requirements are indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Inspect doors and frames on delivery for damage and notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect. Remove and replace damaged items that cannot be repaired as directed.

D. Store doors and frames at building site under cover. Place units on minimum 4-inch- high wood blocking. Do not store doors and frames in nonvented plastic or canvas shelters that could create a humidity chamber. If door packaging becomes wet, remove cartons immediately. Provide minimum 1/4-inch spaces between stacked doors to permit air circulation.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate installation of anchorages 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Steel Doors and Frames:

   a. Black Mountain Door, LLC.

   b. Ceco Door Products; an ASSA ABLOY Group Company.

   c. Curries Company; an Assa Abloy Group company.

   d. De La Fontaine Industries.

   e. The Philipp Manufacturing Company.

   f. Republic Builders Products.

   g. Steelcraft; a division of Allegion.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A60 metallic coating.

D. Supports and Anchors: ASTM A 591/A 591M, Commercial Steel (CS) not less than 0.042 inch (1.0 mm) thickness, 40Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Manufacturer's standard units, hot-dip galvanized according to ASTM A 153/A 153M, Class C or D as applicable.

F. Powder-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.

G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat; or cold-applied asphalt emulsion complying with ASTM D 1187. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers whose products may be incorporated in the Work of this Section include, but are not limited to the following:

a. Karnak Corp.

b. Euclid Chemical Co.

c. Henry Co.

d. W R Meadows, Inc.

2.3 DOORS

A. General: Provide doors of sizes, thicknesses, and designs indicated.

B. Exterior Doors, conforming to:

1. ANSI A250.8 Level 4,

2. Physical Performance Level A (Maximum Duty)

3. Model 2 (Seamless) with door faces fabricated from 0.067 inch (1.7 mm) thick (14 ga.) metallic-coated (galvannealed) steel sheet.

2.4 FRAMES

A. General: Provide steel frames for doors that comply with ANSI A250.8 and with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.

B. Frames of 0.093-inch (2.3-mm) thick (12 gauge) steel sheet, galvanneal-coated, for:

1. Level 4 steel doors.

C. Plaster Guards: Provide 26 gauge (0.016-inch-thick)thick), steel sheet grout guards or mortar boxes to close off interior of openings; place at back of hardware cutouts where mortar or other materials might obstruct hardware operation.

D. Frame Anchors

1. Jamb Anchors:

a. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.

2. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:

a. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

b. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.5 FABRICATION

A. General: Fabricate steel door and frame units to comply with ANSI A250.8 and to be rigid, neat in appearance, and free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site.

B. Exterior Door Construction: For exterior locations and elsewhere as indicated, fabricate doors, panels, and frames from metallic-coated steel sheet. Close top and bottom edges of doors flush as an integral part of door construction or by addition of 16 gauge (0.053-inch-thick)thick), metallic-coated steel channels with channel webs placed even with top and bottom edges.

C. Interior Door Faces: Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from the following material:

1. Cold-rolled steel sheet, unless otherwise indicated.

D. Core Construction: Manufacturer's standard core construction that produces a door complying with SDI standards.

E. Clearances for Non-Fire-Rated Doors: Not more than 1/8 inch at jambs and heads, except not more than 1/4 inch between pairs of doors. Not more than 3/4 inch at bottom.

F. Single-Acting, Door-Edge Profile: Beveled edge.

G. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

H. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold- or hot-rolled steel sheet.

I. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.

J. Thermal-Rated (Insulating) Assemblies: At exterior locations and elsewhere as shown or scheduled, provide doors fabricated as thermal-insulating door and frame assemblies and tested according to ASTM C 236 or ASTM C 976 on fully operable door assemblies.

1. Unless otherwise indicated, provide thermal-rated assemblies with U-value of 0.41 Btu/sq. ft. x h x deg F or better.

K. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door and frame preparation for hardware.

L. Frame Construction: Fabricate frames to shape shown.

1. Exterior Openings:

a. Fabricate frames with mitered or coped and continuously welded corners and seamless face joints.

b. Provide welded frames with temporary spreader bars.

M. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.

2.6 FINISHES

A. Galvannealed Frames and Doors:

1. Repair damage to galvanized metal, and coat welds and areas damaged by welding operations with high-zinc-dust-content paint complying with SSPC-Paint 20.

2. Prime galvanized and/or galvannealed frames and doors in the field with an exterior-grade primer for galvanized metal in accordance with requirements of Division 9 Section “Painting.”

a. Prime top, bottom, edges and faces of doors.

b. Prime all surfaces of frame, including interior surfaces of frame that will not be exposed, and exterior surfaces that will be exposed after installation of frame

3. Finish surfaces of doors and frames that are exposed after installation, and top, bottom, edges and faces of doors with number of finish coats in accordance with requirements of Division 9 Section “Painting.”

a. Spray-apply paint to all surfaces exposed to view.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install steel doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.

B. Placing Frames: Comply with provisions in SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.

1. Place frames before construction of enclosing walls and ceilings.

2. In masonry construction, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.

C. Door Installation: Comply with ANSI A250.8. Fit hollow-metal doors accurately in frames, within clearances specified in ANSI A250.8. Shim as necessary to comply with SDI 122 and ANSI/DHI A115.1G.

3.2 ADJUSTING AND CLEANING

A. Prime-Coat Touchup: Immediately after installation, sand smooth any rusted or damaged areas of prime coat and apply touch up of compatible air-drying primer.

B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION 08 11 13

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing 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. Wall access panels and frames (CMU).
2. Ceiling access panels and frames (GWB).

B. Related Sections include the following:

1. Division 4 Section "Unit Masonry Assemblies" for anchoring and grouting access door frames set in masonry construction.
2. Division 9 Section “Gypsum Board Assemblies” for framed ceilings to receive access panels.

1.3 SUBMITTALS

A. Product Data: For each type of door and frame indicated. Include construction details relative to materials, individual components and profiles, and finishes for access panels and frames.

B. Shop Drawings: Show fabrication and installation details of customized doors and frames. Include plans, elevations, sections, details, and attachments to other Work.

C. Schedule: Provide complete door and frame schedule, including types, general locations, sizes, construction details, latching or locking provisions, and other data pertinent to installation.

D. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items with concealed framing, piping, ductwork, and other construction. Show the following:

1. Ceiling-mounted items including access panels and frames, lighting fixtures, diffusers, grilles, and special trim.
2. Details at not less than 1-1/2” per foot showing method of attaching door frames to surrounding construction.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain doors and frames through one source from a single manufacturer.

B. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.5 COORDINATION

A. Verification: Determine specific locations and sizes for access panels needed to gain access to concealed equipment, and indicate on schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Access panels:
    a. Cierra Products (Babcock-Davis).
    b. J. L. Industries, Inc. (Activar Construction Products Group).
    c. Karp Associates, Inc.
    d. Larsen's Manufacturing Company.
    e. Milcor Limited Partnership.
    f. Nystrom Building Products Co.

2.2 MATERIALS

A. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304; with minimum sheet thickness indicated representing specified thickness according to ASTM A 480/A 480M.

B. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

C. Drywall Beads: Edge trim formed from 0.0299-inch zinc-coated steel sheet formed to receive DAFS and in size to suit thickness of ceiling board.

2.3 PAINT

A. Shop Primers: Provide primers that comply with Division 9 Section "Painting."

B. Shop Primer for Metallic-Coated Steel: Organic zinc-rich primer complying with SSPC-Paint 20 and compatible with topcoat.

2.4 ACCESS PANELS AND FRAMES

A. Flush Access panels and Frames with Exposed Trim: Fabricated from stainless-steel.

1. Locations: Masonry wall surfaces.
2. Door: Minimum 0.078-inch- thick sheet metal, set flush with exposed face flange of frame.
3. Frame: Minimum 0.060-inch- thick sheet metal with 1-inch- wide, surface-mounted trim.
4. Hinges: Spring-loaded concealed pin type.
5. Lock: Key-operated cylinder lock.

B. Flush Access panels and Trimless Frames: Fabricated from stainless-steel.

1. Locations: Interior ceiling surfaces.
2. Door: Minimum 0.078-inch- thick sheet metal, set flush with surrounding finish surfaces.
3. Frame: Minimum 0.060-inch- thick sheet metal with drywall bead.
4. Hinges: Spring-loaded concealed pin type.
5. Lock: Key-operated cylinder lock.

2.5 FABRICATION

A. General: Provide access door assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: Provide materials with smooth, flat No 4 surface finish, without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Steel Doors and Frames: Grind and finish exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.

1. Exposed Flanges: 1 inch wide around perimeter of frame.

2. For trimless frames with drywall bead for installation in gypsum board assembly, provide edge trim for gypsum board securely attached to perimeter of frames.

3. Provide mounting holes in frames to attach frames to metal or wood framing in plaster and drywall construction and to attach masonry anchors in masonry construction. Furnish adjustable metal masonry anchors.

D. Latching Mechanisms: Furnish quantity required to hold doors in flush, smooth plane when closed.

1. For cylinder lock, furnish cylinder for core to match Owner’s key system.

2.6 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

2.7 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. Bright, Directional Polish: No. 4 finish.

1. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 PREPARATION

A. Advise installers of other work about specific requirements relating to access door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access panels and frames.

B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

C. Install access panels with trimless frames flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING AND CLEANING

A. Adjust doors and hardware after installation for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08 31 16

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 types of overhead coiling doors:

1. Insulated garage doors, electrically operated.
2. Insulated counter-service doors, manually operated.

B. Related Sections include the following:

1. Division 5 Section "Metal Fabrications" for miscellaneous steel supports.
2. Division 8 Section "Door Hardware" for lock cylinders and keying.
3. Division 26 Sections for electrical service and connections for powered operators and accessories.

1.3 DEFINITIONS

A. Operation Cycle: One cycle of a door is complete when it is moved from the closed position to the fully open position and returned to the closed position.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design overhead coiling doors, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance, Exterior Doors: Exterior overhead coiling doors shall withstand the wind loads, the effects of gravity loads, and loads and stresses within limits and under conditions indicated according to SEI/ASCE 7.

1. Wind Loads: As indicated on Drawings.
2. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.

C. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.

D. Windborne-Debris-Impact-Resistance Performance: Provide impact-protective overhead coiling doors that pass missile-impact and cyclic-pressure tests when tested according to ASTM E 1886 and ASTM E 1996.

1. Large Missile Test: For overhead coiling doors located within 30 feet (9.144 m) of grade.

E. Seismic Performance: Overhead coiling doors shall withstand the effects of earthquake motions as indicated by Drawings.

F. Operation-Cycle Requirements: Provide overhead coiling door components and operators capable of operating for not less than 20,000 cycles and for 10 cycles per day.

1. Include tamperproof cycle counter.

1.5 SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory. Include the following:

1. Summary of forces and loads on walls and jambs.

B. Delegated-Design Submittal prepared by or under the supervision of a qualified professional engineer: For overhead coiling door indicated to comply with performance requirements and design criteria. Include the following:

1. Shop Drawings signed and sealed by the qualified professional engineer responsible for their preparation:

a. Detail fabrication and assembly of overhead coiling door.

b. Include plans, elevations, sections, details, and attachments to other work.

c. Include details and requirements for connection to electrical power for electrical operators.

2. Structural analysis data and design calculations signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Initial Selection: Manufacturer's color charts showing full range of colors available for units with factory-applied finishes.

D. Samples for Verification: Of each type of exposed finish required, prepared on Samples of size indicated below.

1. Curtain Slats: 12 inches long.

E. Qualification Data: For Installer.

F. Certifications:

1. Submit manufacturer’s Underwriters Laboratories (UL), Warnock Hersey (WH) or Factory Mutual Research (FM) laboratory test report verifying product compliance in accordance with the required fire and smoke ratings.

2. Provide manufacturer’s ICC Evaluation Service report confirming compliance of the fire door assembly in accordance with the requirements of the Building Code.

3. Provide current Notice of Acceptance issued by Miami-Dade County Product Control Section for products to be provided under requirements of this Section for this project, certifying that products are approved for use in Miami-Dade County, and have been designed to comply with the Florida Building Code, including the High Velocity Hurricane Zone.

G. Product Literature: Submit manufacturer's technical literature describing the product to be used under this section.

H. Maintenance and Operating Manuals: Furnish complete manuals describing the materials, devices and procedures to be followed in operating and maintaining all doors under this section. Include manufacturer's brochures and parts lists describing the actual materials used in the product.

1.6 QUALITY ASSURANCE

A. Manufacturer Requirements: Door manufacturer shall have been in the business of and have experience in manufacturing the type of product covered under this specification section as well as giving credible service for a minimum of five (5) years. Provide list of at least ten (10) completed projects which include the products covered under this section.

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project, and with not less than three years verifiable experience installing overhead coiling service doors of types and sizes indicated for this Project.

C. Source Limitations:

1. Obtain overhead coiling doors through one source from a single manufacturer.

2. Obtain operators and controls from overhead coiling door manufacturer.

D. Regulatory Requirements:

1. Comply with applicable requirements of the laws, codes, ordinances and regulations of federal, state and municipal authorities having jurisdiction.

2. Listed by the ICC Evaluation Service in accordance with the applicable sections of the Building Code.

3. Reviewed and accepted by Miami-Dade County RER-Product Control Section to be used in Miami Dade County.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

1.7 COORDINATION

A. Electrical System Roughing-in: Coordinate layout and installation of overhead coiling door electrically powered operators with connections to power supplies, security access control system, and fire alarm system.

1.8 DELIVERY, STORAGE AND HANDLING

A. General: Deliver and store materials in manufacturer's original packaging, labeled to show name, brand, and type. Store materials in a protected dry location off the ground in accordance with manufacturer's instructions.

1.9 WARRANTY

A. Warranty: Manufacturer’s warranty against defects in materials, fabrication and installation of overhead coiling door and operator under conditions of normal use. Failures include but are not limited to the following:

1. Failure to meet performance requirements.

2. Structural failures including excessive deflection.

3. Faulty operation of coiling door and operator.

4. Deterioration of metals, metal finishes and other materials beyond normal wear and tear.

B. Warranty Period: As specified in Section 017830 “Warranties and Bonds.”

PART 2 - PRODUCTS

2.1 OVERHEAD COILING SERVICE DOORS

A. Basis of Design Manufacturer - Overhead Doors:

1. Insulated overhead coiling service doors: The basis of design for insulated overhead coiling service doors is Overhead Door Corporation: Model 625 Stormtite with F265i Slats.

2. Subject to compliance with requirements, provide the named products or comparable products by one of the following:

   a. McKeon Rolling Steel Door Company, Inc.

   b. Cookson Company.

   c. Cornell Iron Works, Inc.

   d. Raynor.

B. Door Curtains: Fabricate overhead coiling door curtain of interlocking slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Insulated Overhead Coiling Doors:

   a. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel (SS) sheet; complying with ASTM A 653/A 653M, G90 (Z275) coating designation.

      1) Minimum Base-Metal (Uncoated) Thickness (front and back): 0.020 inch (24 ga).

      2) Flat profile slats, 3/4 inch depth x 2-5/8 inch height c-c.

   b. Insulation: Fill slat with manufacturer's standard rigid cellular polystyrene or polyurethane-foam-type thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within metal slat faces.

C. Endlocks and Windlocks for Service Doors: Malleable-iron castings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.

D. Bottom Bar for Service Doors: Consisting of 2 angles, each not less than 1-1/2 by 1-1/2 by 1/8-inch-thick; galvanized, stainless-steel, or aluminum extrusions to suit type of curtain slats.

E. Curtain Jamb Guides for Service Doors: Fabricate curtain jamb guides of steel angles or channels and angles, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Build up units with not less than 3/16-inch- thick galvanized steel sections complying with ASTM A 36/A 36M and ASTM A 123/A 123M. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

F. Hood: Form to act as weather seal and entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods and provide fascia

for any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sagging.

1. Fabricate hoods for steel doors of minimum 0.028-inch- thick, hot-dip galvanized steel sheet with G90 zinc coating, complying with ASTM A 653/A 653M.

2. For fire-rated doors include automatic drop baffle to guard against passage of smoke or flame.

G. Weatherseals for doors at exterior openings: Provide replaceable, adjustable, continuous, compressible weather-stripping gaskets fitted to bottom and top of exterior doors, unless otherwise indicated. At door head, use 1/8-inch- thick, replaceable, continuous sheet secured to inside of hood.

1. Provide manually operated chain-gear drive doors with bottom weather seal.

2. In addition, provide replaceable, adjustable, continuous, flexible, 1/8-inch- thick seals of flexible vinyl, rubber, or neoprene at door jambs for a weathertight installation.

H. Push/Pull Handles: For push-up-operated or emergency-operated doors, provide galvanized steel lifting handles on each side of door.

1. Provide pull-down straps or pole hooks for doors more than 84 inches high.

I. Fabricate locking device assembly with lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bar to engage through slots in tracks.

1. Locking Bars: Full-disc cremone type, both jamb sides operable from inside and outside.

2. Lock cylinder is specified in Division 8 Section "Door Hardware."

J. Chain Lock Keeper: Suitable for padlock.

K. Counterbalance Mechanism

1. General: Counterbalance doors by means of adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to door curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

2. Counterbalance Barrel: Fabricate spring barrel of hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.

3. Provide spring balance of one or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Provide cast-steel barrel plugs to secure ends of springs to barrel and shaft.

4. Fabricate torsion rod for counterbalance shaft of cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

5. Brackets: Provide mounting brackets of manufacturer's standard design, either cast iron or cold-rolled steel plate.

2.2 POWER OPERATED DOORS:

A. Motor drive: 1/2 HP, 115/208/230V 1Phase 60HZ,10.0/5.0/5.0 FLA, continuous duty, rated at 60 cycles per hour with integral thermal overload protection system.

1. Disc-type hoist brake ,
2. Electro-mechanical limit switch adjustment,

B. Electronic control board w/

1. LCD display,
2. on-board open/close/stop functions,
3. built in radio receiver,
4. cycle counter,
5. maximum run timer & delay on reverse feature.

C. Gear head reduction shall include integral manual chain hoist override capability

D. Door shall be electrically actuated by

1. Interior mounted NEMA 1 push button requiring continuous contact to operate.
2. Remote control: provide two units, programmed, with batteries.
3. Exterior mounted key switch furnished with a lock cylinder to accept facility's interchangeable small format core.

E. Provide safety interlock switch to disengage power supply when door is locked.

F. Provide personnel safety controls including,

1. 2-wire monitored edge,
2. photo eyes-NEMA 4 (monitored),.

2.3 FINISHES, GENERAL

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.4 STEEL AND GALVANIZED STEEL FINISHES

A. Powder-Coat Finish: Manufacturer's standard powder-coat finish consisting of primer and topcoat according to coating manufacturer's written instructions for cleaning, pretreatment, application, thermosetting, and minimum dry film thickness.

1. Color and Gloss: As selected by Architect from full range of colors including manufacturer's standard colors, premium colors, and custom colors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install coiling doors and operating equipment complete with necessary hardware, jamb and head molding strips, anchors, inserts, hangers, and equipment supports.

3.2 ADJUSTING

A. Lubricate bearings and sliding parts; adjust doors to operate easily, free of warp, twist, or distortion and with weathertight fit around entire perimeter.

3.3 CLEANING

A. Clean curtain and components using non-abrasive materials and methods recommended by manufacturer.

B. Remove labels and visible markings.

C. Touch-up, repair or replace damaged products before Substantial Completion.

3.4 PROTECTION

A. Protect installed products until completion of project.

3.5 STARTUP SERVICES

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION 08 33 23

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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 items known commercially as finish or door hardware that are required for swing, sliding, and folding doors, except special types of unique hardware specified in the same Sections as the doors and door frames on which they are installed. Furnish and deliver all door hardware necessary for all doors, also hardware as specified herein and as enumerated in hardware sets and as indicated and required by actual conditions at the building. The hardware shall include the furnishing of all necessary screws, bolts, expansion shields, drop plates, and all other devices necessary for the proper application of the hardware:

B. ***Hardware Supplier:*** Must employ an experienced ***Architectural Hardware Consultant (AHC)*** who is available to Owner, Architect, and Contractor, at reasonable times during the course of the Work, for consultation.

C. Related Sections:

1. Division 8 Section 08 06 00 “SCHEDULE FOR OPENINGS”.
1. Division 8 Section 08 11 13 “HOLLOW METAL DOORS AND FRAMES.
2. Division 26 “ELECTRICAL".

1.3 REFERENCES

A. Standards:

1. ANSI/BHMA, A156.1 (2013) - Butts & Hinges.
2. ANSI/BHMA, A156.4 (2008) - Door Controls - Closers.
3. ANSI/BHMA, A156.5 (2010) - Auxiliary Locks and Associated Products.
4. ANSI/BHMA, A156.6 (2010) - Architectural Door Trim.
5. ANSI/BHMA, A156.7 (2009) - Template Hinge Dimensions.
6. ANSI/BHMA, A156.8 (2010) - Door Controls - Overhead Stops and Holders.
7. ANSI/BHMA, A156.13 (2012) - Mortise Locks & Latches, Series 1000.
8. ANSI/BHMA, A156.16 (2008) - Auxiliary Hardware
9. ANSI/BHMA, A156.18 (2012) - Materials and Finishes.
10. ANSI/BHMA, A156.21 (2009) - American National Std for Thresholds.
11. ANSI/BHMA, A156.25 (2007) - Electrified Locking Devices.
12. ANSI/BHMA, A156.26 (2012) - Continuous Hinges.
13. ANSI/BHMA, A156.28 (2007) - Recommended Practices for Keying Systems.
14. ANSI/BHMA, A156.29 (2012) - American National Std for Exit Locks & Alarms.

15. ANSI/BHMA, A156.30 (2003) - American National Std for High Security Cylinders.
16. ANSI/BHMA, A156.36 (2010) - American National Standard for Auxiliary Locks.
17. ANSI/BHMA, A156.115 (2006) - Hardware Preparation in Steel Doors and Frames.
18. ANSI/SDI A250.13 (2003) - Testing and Rating of Severe Windstorm Resistant Comp.
19. ASTM E 330 (2002) - Test method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
20. ASTM E 1886 (2002) - Test method for Structural Performance of Exterior Windows, Curtain Walls, Doors, and Storm Shutters Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
21. ASTM E 1996 (2002) - Test method for Structural Performance of Exterior Windows, Curtain Walls, Doors, and Storm Shutters Impacted by Windborne Debris in Hurricanes.
22. FBC-TPHVHZ (2004) - Florida Building Code, Test Protocols for High Velocity Hurricane Zone, TAS (201, TAS (202, TAS (203)
23. NFPA 80 - Fire Doors and Windows.
24. UL10C - Positive Pressure Fire Tests of Door Assemblies.

B. Codes:
   1. Applicable state and local building codes.
   2. 2012 International Building Code as adopted by the State of Connecticut.
   3. NFPA 101 - Life Safety code.
   4. NFPA 105 - Smoke and Draft Control Door Assemblies.
   5. ICC / ANSI A117.1 - Accessible and Usable Buildings and Facilities.
   6. ADA - Americans with Disabilities Act.

C. UL Underwriters Laboratories:
   1. UL 10C – Fire Tests of Door Assemblies.
   2. UL 305 – Panic Hardware.

D. DHI – Door and Hardware Institute:
   1. Sequence and Form and for the Hardware Schedule.
   2. Recommended Locations for Builders Hardware.

1.4 SUSTAINABLE BUILDING REQUIREMENTS AND CRITERIA

A. The Owner requires the Contractor to implement practices and procedures to meet the project's environmental goals, which include achieving compliance with CONNECTICUT HIGH PERFORMANCE BUILDING requirements. Specific project goals which may impact this and the other sections of this specification include: use of recycled-content materials; use of locally-manufactured materials; use of low-emitting materials; use of certified wood products; construction waste recycling; and the implementation of a construction indoor air quality management plan. The Contractor shall ensure that the requirements related to these goals, as

defined in the sections below and in related sections of the contract documents, are implemented to the fullest extent. Substitutions, or other changes to the work proposed by the Contractor or their Subcontractors, shall not be allowed if such changes compromise the stated CONNECTICUT HIGH PERFORMANCE BUILDING criteria.

1.5 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Section 1 Specification Sections:

B. Product data including manufacturer's technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish of door hardware.

C. Final hardware schedule must be coordinated with doors, frames, and related work to ensure proper size, thickness, hand function, and finish of door hardware. Conflicts between the SPECIFIED DOOR HARDWARE and the DOORS / FRAMES must be brought to the attention of the ARCHITECT prior to submitting HARDWARE SUBMITTAL to the ARCHITECT.

D. HARDWARE SUPPLIER shall confirm specified LOCK FUNCTIONS with the OWNER at the KEYING MEETING.

1. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into *"HARDWARE SETS"* indicating complete designation of every item required for each door or opening. Include the following information. Type, style, function, size, and finish of each hardware item.
   a. Name and manufacturer of each item.
   b. Fastenings and other pertinent information.
   c. Location of Hardware Set, cross-referenced to indication of Drawings both on floor plans, in door, and frame schedule.
   d. Explanation of all abbreviations, symbols, and codes contained in schedule.
   e. Mounting locations for hardware. Provide "DHI" Standard Mounting Locations in the Hardware Submittal.
   f. Door and frame sizes and materials.
   g. Keying information.
   h. *Door handles, pulls, latches, locks and other operating devices shall be installed 34 inches (864 mm) minimum and 48 inches (1219 mm) maximum above the finish floor. Locks used only for security purposes and not used for normal operation are permitted at any height.*

2. Submittal Sequence: submit final schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other work that is critical in the Project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by door hardware, and other information essential to the coordinated review to schedule.

3. Keying Schedule: After a keying meeting between representatives of the Owner, Architect, hardware supplier, and, if requested, the representative for the lock manufacturer, provide a keying schedule, listing the levels of keying, as well as an explanation of the key system's function, the key symbols used, and the door numbers controlled.

E. Samples: If requested by Architect, submit samples of each type of exposed hardware unit in finish indicated and tagged with full description for coordination with schedule. Submit samples prior to submission of final hardware schedule:

1. Samples will be returned to the supplier. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated in the Work, within limitations of keying coordination requirements.

F. Templates for doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

G. Wiring Diagrams: Upon final approval of the hardware schedule, submit wiring and riser diagrams as required for the complete and proper installation of all electrical, electromechanical, and electromagnetic products. Submittals must represent that coordination has occurred with the security system submittals and shop drawings. Also, that shop drawings submitted and schedules developed have been specifically reviewed and coordinated for both physical equipment fitment and power requirements with the security system contractor approved shop drawings.

H. "Hardware Schedule and Templates", Hardware schedules shall be created which reference specifically to the specified lock voltages and separately indicating whether the door is a "fail safe" or "fail secure" electrified lock arrangement.

I. Electrified Hardware: Electrified Hardware to be used for security purposes must be UL Listed for Burglary Applications.

J. At the completion of hardware installation, and prior to issuance of certificate of occupancy, prepare and submit the hardware inspection report to include the following:

1. Current and predictable problems of substantial nature in the performance of the hardware.

2. Hardware has been installed and adjusted in accordance with manufacturer's recommendations and instructions.

K. At the completion of the project, provide Owner with two (2) copies of an Operation and Maintenance Manual. This manual shall consist of a hard cover (3) ring binder with the project name listed on the front. Included will be:

1. A final copy of the approved and as built hardware schedule.

2. A final copy of the approved keying schedule.

3. Catalog cuts for each item used in the project.

4. Parts list and numbers for each item used.

5. Maintenance instructions for all items.

6. Name, address, and phone number of local representative for each item used.

1.6 QUALITY ASSURANCE

A. Substitutions: Products are to be those specified to ensure a uniform basis of acceptable materials. Requests for substitutions must be made in accordance with Section 1 requirements. If proposing a substitute to a specified item, indicate basis for substitution and savings to be made. Provide sample if requested. Certain products have been selected for their unique characteristics and particular project suitability. All Hardware is "Basis-of-Design" product specification as defined in Section 08 71 00. Model numbers (and Manufacturer's) listed in "Hardware Set Schedule" are "Basis-of-Design".

1. Items specified, as "no substitution" shall be provided exactly as listed.

2. Items listed with no substitute manufacturers listed have been requested by the Owner or Architect to match existing for continuity and/or future performance and maintenance standards or because there is no known equal product.

3. If no other products are listed in a category, then "no substitution" is implied.

B. Supplier Qualifications: A recognized architectural door hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, architect, and Contractor, at reasonable times during the course of the Work, for consultation.

1. Require supplier to meet with Owner to finalize keying requirements and to obtain final instructions in writing.

C. A pre-installation meeting shall be held to instruct installers on the proper installation and adjustment of door hardware. A representative of each major hardware category, including, but not limited to, Locks, Exit Devices, & Closers, shall instruct the installers on the correct installation of their products. The manufacturers of the Door Hardware provided on this project shall certify to the Architect that the door hardware installer for this project has been trained in the proper installation procedures and is certified to install the door hardware.

D. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed and are identical to products tested by UL, Intertek Testing Services, Warnock Hersey, Factory Mutual, or other testing and inspecting organization acceptable to authorities having jurisdiction for use on types and sizes of doors indicated in compliance with requirements of fire-rated door and door frame labels.

E. Accessible Hardware: Door Hardware; *Handles, pulls, latches, locks and other operable parts on accessible doors shall have a shape that is easy to grasp with one hand and does not require tight grasping, pinching, or twisting of the wrist to operate. Such hardware shall 34 inches (865 mm) minimum and 48 inches (1220 mm) maximum above the floor or ground. Where sliding doors are in the fully open position, operating hardware shall be exposed and usable from both sides.* EXCEPTION: *Locks used only for security purposes and not used for normal operation are permitted in any location.*

F. Accessible Hardware: Door-Opening Force; Fire Doors shall have the minimum opening force allowable by the appropriate administrative authority. The maximum force for pushing open or pulling open doors other than fire doors shall be as follows:

1. Interior hinged door: 5.0 pounds.

2. Sliding or folding door: 5.0 pounds.

3. Fire Doors: Minimum opening force allowable by authorities having jurisdiction, but not greater than 10 lbf. *These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position. The maximum force required to release the latch shall not exceed 15 lbf.*

4. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.

5. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

1.7 PRODUCT HANDLING

A. Tag each item or package separately with identification related to final hardware schedule, and include basic installation instructions with each item or package.

B. Each item of hardware shall be individually packaged in manufacturer's original container.

C. Receiving and storing of door hardware is responsibility of supplier. Prior to delivery of door hardware to the project, Hardware Supplier must sort and clearly mark with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in same container.

D. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.

E. Deliver individually packaged door hardware items promptly to place of installation (shop or Project site).

F. Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.

1.8 MAINTENANCE

A. Maintenance Tools and Instructions: Furnish two (2) complete sets of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware. Furnish two (2) extra screws or fasteners of each type size and of the same finish used in this project.

1.9 WARRANTY

A. Provide manufacturer's warrantees as follows:

1. Closers: As specified in Section 017830 "Warranties and Bonds."
2. Exit Devices: As specified in Section 017830 "Warranties and Bonds."
3. Hinges: As specified in Section 017830 "Warranties and Bonds."
4. Continuous Hinges: As specified in Section 017830 "Warranties and Bonds."
5. All other hardware: As specified in Section 017830 "Warranties and Bonds."

B. Starting date for all warranty periods to be date of substantial completion of the Project.

C. No liability is to be assumed where damage or faulty operation is due to improper installation, improper use, or abuse.

D. Products judged to be defective during the warranty period shall be replaced or repaired in accordance with the manufacturer's warranty, at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Butts and Hinges:
   a. Hager Companies.

b. Bommer.
c. Ives, Allegion.
d. PBB World Class Hinges.
e. Stanley Hardware.

2. Continuous Hinges:
   a. Hager Companies.
   b. Bommer.
   c. Ives, Allegion.
   d. PBB World Class Hinges.
   e. Pemko
   f. Select

3. Key Control System:
   a. HPC.
   b. Lund, Inc.
   c. Telkee, Inc.

4. Cylinders and Locks:
   a. Sargent, Div of Assa Abloy “64-8200-LNL-US26D” Series.
   b. DG1 6300 Keying Core – US26D

5. Flush Bolts:
   a. Hager Companies.
   b. Glynn Johnson, Allegion.
   c. Ives, Allegion.
   d. Rockwood Manufacturing.
   e. Trimco Triangle Brass.

6. Push/Pull Units:
   a. Hager Companies.
   b. Burns Manufacturing, Inc
   c. Ives, Allegion.
   d. Rockwood Manufacturing

7. Overhead Surface Closers:
   a. Sargent, Div of Assa Abloy, Inc., “351 (Heavy Duty Arms)” Series.

8. Door Control Devices:
   a. DORMA Architectural Hardware.
   b. Burns Manufacturing, Inc.
   c. Glynn Johnson, Allegion.
   d. MAG Security.
   e. Rixson, Div of Assa Abloy.
   f. Sargent, Div of Assa Abloy.

9. Kick and Mop Plates:
   a. Hager Companies.
   b. Burns Manufacturing, Inc.
   c. Ives, Allegion.

d. Rockwood.

10. Weather-stripping and Seals:
    a. Hager Companies.
    b. National Guard Products.
    c. Pemko Manufacturing Co., Inc.
    d. Reese Enterprises, Inc.

11. Thresholds:
    a. Hager Companies.
    b. National Guard Products.
    c. Pemko Manufacturing Co., Inc.
    d. Reese Enterprises, Inc.

12. Astragals:
    a. Hager Companies.
    b. National Guard Products.
    c. Pemko Manufacturing Co., Inc.
    d. Reese Enterprises, Inc.

13. Door Stops:
    a. Hager Companies.
    b. Burns Manufacturing, Inc
    c. Glynn Johnson, Allegion
    d. Ives, Allegion.
    e. Rockwood Manufacturing.

14. Electrified Hinges:
    a. Hager Companies.
    b. Bommer.
    c. PBB World Class Hinges.
    d. Stanley Hardware.

15. Electrified Power Transfers:
    a. DORMA Architectural Hardware.
    b. Locknetics, Allegion.
    c. Security Door Controls.
    d. Securitron, Div of Assa Abloy.
    e. Von-Duprin, Allegion.

2.2 SCHEDULED HARDWARE

A. Requirements for each type of door hardware are indicated on the “Door Schedule”, and in the Schedule at the end of this Section. Products are identified by using hardware designation numbers of the following:

1. Manufacturer’s Product Designations: The product designation and name of one manufacturer are listed for each hardware type required for the purpose of establishing minimum requirements. Manufacturer and model numbers indicated in Hardware Sets constitute a “Basis-of-Design” product specification as defined in this Section.

2.3 MATERIALS AND FABRICATION

A. Manufacturer's Name Plate: Do not use manufacturers' products that have manufacturer's name or trade name displayed in a visible location (omit removable nameplates) except in conjunction with required fire-rated labels and as otherwise acceptable to Architect.

1. Manufacturer's identification will be permitted on rim of lock cylinders only.

B. Base Metals: Product hardware units of basic metal and forming methods indicated, using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized), quality than specified for applicable hardware units by applicable ANSI/BHMA A156 series standards for each type of hardware item and with ANSI/BHMA A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.

C. Fasteners: Provide hardware manufactured to conform to published templates generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.

D. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive paint.

E. Provide concealed fasteners. Provide tamper resistant fasteners when they cannot be concealed. Fasteners shall be of the same finish as the balance of the hardware. Where thru-bolts are used as a means of reinforcing the work, provide sleeves for each thru-bolt or use sex screw fasteners.

2.4 HINGES, BUTTS, AND CONTINUOUS HINGES

A. Templates: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.

B. Screws: Provide Phillips flat-head screws complying with the following requirements:

1. For metal doors and frames install machine screws into drilled and tapped holes.
2. For wood doors and frames install wood screws.
3. For fire-rated wood doors install #12 x ¼ inch, threaded-to-the-head steel wood screws.
4. Finish screw heads to match surface of hinges or pivots.

C. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

1. Out-Swing Exterior Doors: Non-removable pins.
2. Interior Doors: Non-rising pins.
3. All "Card Reader Doors": Non-removable pins.

D. Number of Hinges: Provide number of hinges indicated but not less than 3 hinges per door leaf for doors 90 inches of additional height:

1. Fire-Rated Doors: Not less than 3 hinges per door leaf for doors 86 inches or less in height with same rule for additional hinges.

E. Size and weight of butts:

1. See Hardware Sets for Details.

2.5 LOCK CYLINDERS AND KEYING

A. Review the keying system with the Owner and key to existing master key system.

B. HARDWARE SUPPLIER SHALL CONFIRM SPECIFIED LOCK FUNCTIONS WITH OWNER AT THE KEYING MEETING.

C. Equip locks with manufacturer's 6-pin tumbler "interchangeable core" cylinder employing "RESTRICTED KEYWAY". Such cylinders have cores that are removable by the use of a special "control key". Deliver hardware to the contractor with temporary cores installed and keyed alike. Permanent cores are to be mastered keyed as directed by the owner. Deliver permanent cores and keys to the owner when notified by the owner in writing. Temporary cores and keys are to be returned to the hardware supplier by the contractor within 10 days of their replacement by permanent cores. (Do Not Provide Extra Key Blanks if Restricted Keyway has been specified.)

1. Furnish 12 each "Temporary Change Keys" and 2 each "Temporary Core Control Keys".
2. Key Quantity: Furnish 3 change keys for each lock, 5 master keys for each master system, and 5 grandmaster keys for each grandmaster system. Furnish 6 each "Core Control Keys".
3. Furnish 12 Temporary Change Keys and 2 Temporary Core Control Keys.
4. Furnish 12 each additional core for owner's stock.
5. Install "FINAL CORES" when instructed by Owner.
6. Deliver keys to Owner.

D. Metals: Construct lock cylinder parts from brass or bronze, stainless steel, or nickel silver.

E. Comply with Owner's instructions for master keying and, except as otherwise indicated, provide individual change key for each lock that is not designated to be keyed alike with a group of related locks.

F. Key Material: Provide keys of nickel silver only.

G. Final cores to be installed by the hardware supplier, installer must verify that all cylinders are working correctly.

2.6 KEY CONTROL SYSTEM

A. Provide a key control system including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150 percent of the number of "Key Sets" required for the Project:

1. Provide flat lip strikes for locks with 3 pieces, anti-friction latchbolt as recommended by manufacturer.

2.7 LOCKS, LATCHES, AND BOLTS

A. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set, unless otherwise indicated:

1. Provide complete cross-index system set up by key control manufacturer, and place keys on markers and hooks in the cabinet as determined by the final key schedule.
2. Provide hinged-panel type cabinet for wall mounting.

B. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the 2010 ADA Standards, ICC/ANSI A117.1.

1. Comply with the following maximum opening-force requirements:

a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.

b. Folding Doors: 5 lbf applied parallel to door at latch.

c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction, but not greater than 10 lbf.

2. Comply with the following maximum closing speed requirements:

a. Adjust closers so that from an open position of 90 degrees, the time required to move the door to an open position of 12 degrees is to be 5 seconds minimum.

b. Adjust closers so that from an open position of 70 degrees, the time required to move the door to an open position of 3 inches from the latch is to be 3 seconds minimum.

C. Mortise Locks:

1. Mortise locks shall be certified as ANSI A156.13, Series 1000, Operational and Security Grade 1, and meets A117.1 Accessibility Code, and shall be manufactured from heavy gauge steel, containing components of steel with zinc dichromate plating for corrosion resistance. Lock case shall be multi-function and field reversible for handling.

2. Locks are to have a standard 2-3/4" backset with a full ¾" throw 2-piece stainless steel mechanical anti-friction latch-bolt.

3. Lever trim shall be solid brass, bronze, or stainless steel, cast or forged in the design specified, with wrought roses and external Security requirement. Levers shall be thru-bolted to assure proper alignment, and shall have a 2-piece spindle. Lever trim on the secure side of doors serving rooms considered by the authority having jurisdiction to be hazardous shall have a tactile warning.

2.8 CLOSERS AND DOOR CONTROL DEVICES

A. Size of Units: Except as otherwise specifically indicated, comply with the manufacturer's recommendations for size of door control unit depending on size of door, exposure to weather, and anticipated frequency of use:

1. Where parallel arms are indicated for closers, provide closer with Heavy Duty Arm.

2. Provide parallel arms for all overhead closers, except as otherwise indicated Provide parallel arms for all overhead closers, except as otherwise indicated.

3. Closers must operate at 180 degree opening where indicated on plans and door schedule.

4. Provide all necessary Drop Plate Brackets, Shims, and Angle Brackets, where required to complete installation of closers on doors and frames.

5. Furnish and Install "THRU BOLTS" on Aluminum, Hollow Metal, and Wood Doors.

B. Access-Free Manual Closers: Where manual closers are indicated for doors required to be accessible to the physically handicapped, provide adjustable units complying with ANSI A117.1 provisions for door opening force and closing speed.

C. Combination Door Closers and Holders: Where indicated, provide units designed to hold door in open position under normal usage and to release and close door automatically under normal usage

and to release and close door automatically under fire conditions. Incorporate and integral electromagnetic holder mechanism designed for use with UL listed fire detectors, provided with normally closed switching contacts.

D. Coordinators: Provide Door Coordinators where required, including Parallel Arm Brackets. Verify bracket configuration with frame profile for each opening requiring door coordinator.

Magnetic Holders: Provide wall- or floor-mounted electromagnetic door release with a minimum of 25 pounds of holding force. Projection of holder and armature must be coordinated with other hardware and wall conditions to ensure that door sits parallel to wall when fully open. Where magnetic holders are used on fire-rated doors, they must be wired into the fire control panel for fail-safe operation.

2.9 DOOR STOPS AND HOLDERS

A. It shall be the responsibility of the hardware supplier to provide door stops for all doors in accordance with the following requirements. Provide Door Stops as indicated in Hardware Sets.

2.10 DOOR TRIM UNITS

A. Fasteners: Provide manufacturer's standard exposed fasteners for door trim units consisting of either machine screws or self-tapping screws.

B. Fabricate protection plates not more than 2 inches less than door width on push side of door and by height indicated.

1. Metal Plates: Stainless steel, 0.050 inch (U.S. 18 gage):

2.11 THRESHOLDS, WEATHER-STRIPPING, SOUND STRIPPING AND SEALS

A. Match items to the manufacturer's standard color and texture finish for the latch and lock sets (or push-pull units if not latch or lock sets).

2.12 MISCELLANEOUS HARDWARE

A. Furnish four (4) extra screws or fasteners of each type, used for the hinges, door closers, holders and protective plates of the same finish used in this project.

B. Furnish two (2) additional adjusting wrenches for the door closers.

2.13 HARDWARE FINISHES

A. Match items to the manufacturer's standard color and texture finish for the latch and lock sets (or push-pull units if not latch or lock sets).

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

C. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18, "Materials and Finishes", including coordination with the traditional U.S. finishes show by certain manufacturers for their products.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation of any hardware, examine all doors, frames, walls and related items for conditions that would prevent proper installation of door hardware. Correct all defects prior to proceeding with installation.

3.2 INSTALLATION

A. All hardware to be installed by qualified tradesmen, skilled in the application of commercial grade hardware. For technical assistance if necessary, installers may contact the manufacturer's rep for the item in question.

B. Furnish and Install "THRU BOLTS" on Hollow Metal and Wood Doors.

C. Electronic hardware shall be furnished and installed by qualified tradesmen, but shall be wired by the security system contractor. Door Hardware installer shall be present to complete final adjustments to door hardware, when security contractor completes electrical terminations.

D. Mount hardware units at heights indicated in "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.

E. Install each hardware item in compliance with the manufacturer's instructions and recommendations, using only the fasteners provided by the manufacturer.

F. Do not install surface mounted items until finishes have been completed on the substrate. Protect all installed hardware during painting.

G. Set units' level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

H. All operating parts shall move freely and smoothly without binding, sticking, or excessive clearance.

3.3 ADJUSTING, CLEANING, AND DEMONSTRATING

A. Adjust and check each operating item of hardware and each door, to insure proper operation or function of every unit. Replace units, which cannot be adjusted to operate freely and smoothly.

B. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy to perform a final check and adjustment of all hardware items in such space or area. Clean operating doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

C. Clean adjacent surfaces soiled by hardware installation.

D. At the completion of "BALANCING" of all "AIR HANDLING SYSTEMS", prior to owner taking occupancy, 'Hardware Installer" will re-adjust all closer closing and latching cycles.

E. Approximately six months after the Date of Substantial Completion, the installer shall perform the following:

1. Examine and readjust each item of door hardware as necessary to ensure function of doors, door hardware, and electrified hardware.

2. Consult with and instruct owners' personnel on recommend maintenance procedures.

3. Replace door hardware items that have deteriorated or failed due to faulty design, materials, or installation of door hardware units.

3.4 FIELD QUALITY CONTROL

A. Prior to Substantial Completion, the installer, accompanied by representatives of the manufacturers of latchsets and locksets, door closers, and exit devices, and of other major hardware suppliers, shall perform the following work.

B. Examine (by representatives of the manufacturers) and re-adjust (by hardware installer) each item of door hardware as necessary to restore function of doors and hardware to comply with specified requirements.

C. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures.

D. Replace hardware items that have deteriorated or failed due to faulty design or materials (work to be performed by representatives of the manufacturers including removal and reinstallation).

E. Replace hardware items that have deteriorated or failed due to incorrect installation (work to be performed by hardware installer including removal and reinstallation) of hardware units.

F. Prepare a written report of current and predictable problems of substantial nature in the performance of the hardware.

3.5 PROTECTION

A. Provide for the proper protection of all items of hardware until the Owner accepts the project as complete. Damaged or disfigured hardware shall be replaced or repaired by the responsible party.

3.6 HARDWARE SCHEDULE

A. General: Provide hardware for each door to comply with requirements of this Section, Door and Hardware Schedule Section 08 06 10", and the following Hardware Sets. The door hardware sets listed herein shall not be considered as a complete hardware schedule and shall only be considered as an indication of the hardware requirements desired by the Owner. It shall be this Contractor's responsibility to visit the site, examine the drawings and door schedule and provide all necessary hardware as shown. Such items shall be of same quality, quantity and type as that scheduled for similar doors or parts of the building used for similar purposes.

B. Conflicts between the SPECIFIED DOOR HARDWARE and the DOORS / FRAMES must be brought to the attention of the ARCHITECT prior to submitting HARDWARE SUBMITTAL to the ARCHITECT.

Hardware Set 051

1	Hinge, Continuous Geared	780 - 224 HD - 83" - CLEAR - Concealed Leaf - RETW-QC (10-Wire)	Roton
1	Mortar Box	430	Hager
1	Electrically Unlocked	LX RX 64-8271-24V LNL (Fail Secure)	Sargent
1	Cylinder, IC Core	DG1 6300	Sargent
1	Closer, Overhead Parallel Arm	351 - CPS - EN	Sargent
1	Kick Plate	K1050 - 16" x 34" - 18 ga. - US32D	Rockwood
1	Weatherstrip	316AS - 36" x 84"	Pemko
1	Door Bottom Sweep	315CN x 36"	Pemko
1	Overhead Rain Drip	346C x 40"	Pemko
1	Threshold	195A x __A (Fluted Plate) x 196A (Supp) x 195A x (Frm Depth) - 1 Welded Unit x 36" W x 1/2" H	Pemko
1	Power Supply	Power Supply by Security Section	By Others
1	Diagrams	Diagrams - Elevation and Riser	By MFR
1	Diagrams	Diagrams - Point To Point	By MFR

Hardware Set 061

1	Hinge, Continuous Geared	780 - 224 HD - 83" - CLEAR - Concealed Leaf	Roton
1	Lock, Deadbolt - Classroom	64-4877 - US26D	Sargent
1	Cylinder, IC Core	DG1 6300	Sargent
1	Push Plate	70C - 4" x 16" - US32D	Rockwood
1	Pull Plate	BF-107 - 70C - 4" x 16" - US32D	Rockwood
1	Closer, Overhead Parallel Arm	351 - CPS - EN	Sargent
1	Kick Plate	K1050 - 16" x 34" - 18 ga. - US32D	Rockwood
1	Weatherstrip	316AS - 36" x 84"	Pemko
1	Door Bottom Sweep	315CN x 36"	Pemko
1	Overhead Rain Drip	346C x 40"	Pemko
1	Threshold	195A x __A (Fluted Plate) x 196A (Supp) x 195A x (Frm Depth) - 1 Welded Unit x 36" W x 1/2" H	Pemko

Hardware Set 062

1	Hinge, Continuous Geared	780 - 224 HD - 83" - CLEAR - Concealed Leaf	Roton
1	Lockset, Privacy w/Dead Bolt	64-8225 - LNL - US26D ("OCCUPIED / VACANT")	Sargent
1	Cylinder, IC Core	DG1 6300	Sargent
1	Closer, Overhead Parallel Arm	351 - CPS - EN	Sargent
1	Kick Plate	K1050 - 16" x 34" - 18 ga. - US32D	Rockwood
1	Weatherstrip	316AS - 36" x 84"	Pemko
1	Door Bottom Sweep	315CN x 36"	Pemko
1	Overhead Rain Drip	346C x 40"	Pemko
1	Threshold	195A x __A (Fluted Plate) x 196A (Supp) x 195A x (Frm Depth) - 1 Welded Unit x 36" W x 1/2" H	Pemko

Hardware Set 067

2	Hinge, Continuous Geared	780 - 224 HD - 83" - CLEAR - Concealed Leaf	Roton
1	Lockset, Storeroom	64-8204 - LNL - US26D	Sargent
1	Cylinder, IC Core	DG1 6300	Sargent
2	Bolt, Flush	555 - US26D	Rockwood
1	Dust Proof Strike	570 - US26D	Rockwood
1	Closer, Overhead Parallel Arm	351 - CPSH - EN (HD - Hold Open / Stop Arm at 110 Degrees) (RHR-ACT LEAF)	Sargent
1	Holder/Stop, Overhead - Surf.	9ADJ-326 - Hold Open - (33-1/16" - 38" Door) - 689 @ LHR INACTIVE LEAF	Rixson
1	Weatherstrip	316AS - 72" x 84"	Pemko
1	Astragal, Overlapping	357SP w/S88 x 84" (Apply to inside face of LHR In-Active Leaf)	Pemko
2	Door Bottom Sweep	315CN x 36"	Pemko
1	Overhead Rain Drip	346C x 76"	Pemko
1	Threshold	195A x __A (Fluted Plate) x 196A (Supp) x 195A x (Frm Depth) - 1 Welded Unit x 72" W x 1/2" H	Pemko

Hardware Set 201

1	Hinge, Continuous Geared	780 - 224 HD - 83" - CLEAR - Concealed Leaf	Roton
1	Lockset, Classroom	64-8237 - LNL - US26D	Sargent
1	Cylinder, IC Core	DG1 6300	Sargent
1	Closer, Overhead Parallel Arm	351 - CPS - EN	Sargent
1	Kick Plate	K1050 - 16" x 34" - 18 ga. - US32D	Rockwood
1	Weatherstrip	316AS - 36" x 84"	Pemko
1	Door Bottom Sweep	315CN x 36"	Pemko
1	Overhead Rain Drip	346C x 40"	Pemko
1	Threshold	195A x __A (Fluted Plate) x 196A (Supp) x 195A x (Frm Depth) - 1 Welded Unit x 36" W x 1/2" H	Pemko

Hardware Set 401

1	Hinge, Continuous Geared	780 - 224 HD - 83" - CLEAR - Concealed Leaf	Roton
1	Lockset, Storeroom	64-8204 - LNL - US26D	Sargent
1	Cylinder, IC Core	DG1 6300	Sargent
1	Closer, Overhead Parallel Arm	351 - CPS - EN	Sargent
1	Kick Plate	K1050 - 16" x 34" - 18 ga. - US32D	Rockwood
1	Weatherstrip	316AS - 36" x 84"	Pemko
1	Door Bottom Sweep	315CN x 36"	Pemko
1	Overhead Rain Drip	346C x 40"	Pemko
1	Threshold	195A x __A (Fluted Plate) x 196A (Supp) x 195A x (Frm Depth) - 1 Welded Unit x 36" W x 1/2" H	Pemko

END OF SECTION 08 71 00

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. Fixed, extruded-aluminum louvers.

B. Related Sections include the following:

1. Division 7 Section "Joint Sealants" for sealants installed in perimeter joints between louver frames and adjoining construction.

2. Division 23 Sections for louvers that are a part of mechanical equipment to the extent not specified herein.

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

1.4 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Provide louvers that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

B. Air-Performance, Water-Penetration, Air-Leakage, and Wind-Driven Rain Ratings: Provide louvers complying with performance requirements indicated, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include details of installation and related construction, frame and louver dimensions, profiles and finishes.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other Work. Show blade profiles, angles, and spacing.

1. For installed louvers and vents indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of metal finish required.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain louvers and vents through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.2, "Structural Welding Code--Aluminum."

C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

D. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Basis-of-Design Product: The design for each louver is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 MATERIALS

A. Aluminum Extrusions: ASTM B 221, alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209, alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

C. Fasteners: Of same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.

1. Use types and sizes to suit unit installation conditions.

2. Use Phillips flat-head screws for exposed fasteners, unless otherwise indicated.

D. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

E. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

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

a. Karnak Corp.

b. Euclid Chemical Co.

c. Henry Co.

d. W R Meadows, Inc.

2.3 EXTRUDED ALUMINUM ARCHITECTURAL LOUVERS

A. Fabrication, General

1. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

2. Maintain equal louver blade spacing to produce uniform appearance.

3. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

4. Include supports, anchorages, and accessories required for complete assembly.

5. Fabricate extruded-aluminum louver frames from channel, unless otherwise indicated.

6. Where indicated, provide subsills made of same material as louvers for recessed louvers.

7. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

B. Horizontal Fixed Blade, Storm-Resistant Louver:

1. Basis-of-Design Product: Airolite Company; Model K605D or a comparable product of one of the following:

a. American Warming and Ventilating, Inc.

b. Arrow United Industries.

c. Construction Specialties, Inc.

d. Industrial Louvers, Inc.

e. Ruskin Company.

f. Louvers & Dampers, Inc.

g. Metal Form Manufacturing Company, Inc.

h. Vent Products Company, Inc.

2. Louver Depth: 5 inches.

3. Frame and Blade Nominal Thickness: As required to comply with structural performance requirements, but not less than 0.080 inch for blades and 0.080 inch for frames.

a. Performance Requirements:

1) Free Area: Not less than 9.11 sq. ft. (0.85 sq. m.) for 48-inch- (1220-mm-) wide by 48-inch- (1220-mm-) high louver.

2) Airflow Resistance: Not more than 0.40-inch wg static pressure drop at beginning point of water penetration.

3) Water Penetration: Not more than 0.01 oz. of water penetration per square foot (3.05 g of water penetration per m^2) of louver free area at 1134 fpm (5.8-m/sec) free area velocity at standard air density of 0.075 lbs/ft^3 (1.201 kg/m^3) when tested for water penetration according to AMCA 500-L "Laboratory Methods of Testing Louvers for Rating."

C. Louver Screens

1. General: Provide screen at each exterior louver.

a. Screen Location for Fixed Louvers: Interior face.

b. Screening Type:

1) Bird screening at louver at intake connected to mechanical equipment.

2) Insect screening at louvers not connected to ductwork and at louvers at exhaust connected to mechanical equipment.

2. Secure screens to louver frames with stainless-steel machine screws, spaced a maximum of 6 inches from each corner and at 12 inches o.c.

3. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.

a. Metal: Same kind and form of metal as indicated for louver to which screens are attached.

b. Finish: Same finish as louver frames to which louver screens are attached.

c. Type: Non-rewirable, U-shaped frames for permanently securing screen mesh.

4. Louver Screening for Aluminum Louvers:

a. Bird Screening: Aluminum, 1/2-inch- square mesh, 0.063-inch wire.

b. Insect Screening: Aluminum, 18-by-16 mesh, 0.012-inch wire.

D. Finishes, General

1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2. Finish louvers after assembly.

E. Aluminum Finishes

1. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.

2. High-Performance Organic-Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

a. Fluoropolymer Two-Coat Coating System: Manufacturer's standard two-coat, thermocured system consisting of specially formulated inhibitive primer, fluoropolymer color coat, and clear fluoropolymer topcoat, with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2605.

1) Color and Gloss: As selected by Architect from custom colors AND to exactly match colors and sheen of the newly constructed existing High School.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

F. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 7 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Replace louvers and vents damaged during installation and construction.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 08 90 00

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. Exterior gypsum board panels for interior and exterior ceilings and soffits.

B. Related Sections include the following:

1. Division 6 Section “Miscellaneous Carpentry” for wood framing and furring.
2. Division 7 Section "Building Insulation" for insulation installed in gypsum board assemblies.

1.3 DEFINITIONS

A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 SUBMITTALS

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

B. Shop Drawings for gypsum walls and soffits: Show layout, spacing, sizes, thicknesses, and types of framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, control and expansion joints, accessories, connection details, and attachment to adjoining Work. Show coordination of the work of this Section with the work of other trades affected by the work of this Section.

C. Samples: For the following products:

1. Trim Accessories: Full-size sample in 12-inch- long length for each trim accessory indicated.
2. VOC Content: For adhesives, including printed statement of VOC content.

1.5 QUALITY ASSURANCE

A. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review methods and procedures for installing gypsum board assemblies.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Handle and store framing materials and related accessories to maintain as-new condition up to time of installation.

1. Store materials inside under breathable cover.
2. Keep materials dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.
3. Stack gypsum panels flat to prevent sagging.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, out-of-plane, moisture damaged, or mold damaged

PART 2 - PRODUCTS

2.1 EXTERIOR GYPSUM PANELS FOR INTERIOR AND EXTERIOR CEILINGS AND SOFFITS

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M.

1. Type and Thickness: Regular, 5/8 inch thick.
    a. Product: Subject to compliance with requirements, provide one of the following:
        1) United States Gypsum Co.; “SECUROCK Glass Mat Sheathing.”
        2) Georgia-Pacific Corp.: "Dens-Glass Gold."
        3) National Gypsum Co.: “e^{2}XP Sheathing.”
        4) BPB America Inc.: “GlasRoc.”
        5) LaFarge/Continental: “Weather Defense.”

2.2 TRIM ACCESSORIES

A. Exterior Trim: ASTM C 1047.

1. Material: Hot-dip galvanized steel sheet or rolled zinc.
2. Shapes:
    a. Cornerbead: Use at outside corners.
    b. LC-Bead: J-shaped; exposed long flange receives joint compound; use at exposed panel edges.

2.3 JOINT TREATMENT MATERIALS

A. General: Refer to Direct Applied Finish Systems, which will be used as interior and exterior finish.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: As follows:

1. Use screws complying with ASTM C 1002 Type W for fastening panels to wood members coated or electro galvanized to resist rust.

D. Isolation Strip at Exterior Walls:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.

2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size

E. Thermal Insulation: As specified in Division 7 Section "Building Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate installation of furring with maximum available panel dimensions and penetration locations.

3.3 INSTALLING STEEL FRAMING, GENERAL

A. Installation Standards: ASTM C1396

B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."

C. Isolate ceiling furring from masonry building structure at perimeter locations indicated to prevent transfer of loading imposed by structural movement.

1. Isolate ceiling assemblies where they abut or are penetrated by building structure.

D. Do not bridge building control and expansion joints with framing or furring members. Frame both sides of joints independently.

E. Installation Tolerance:

1. Openings: Frame openings square to required rough opening.

2. Spacing of framing members: Spacing of individual members shall not vary by more than 1/8 inch from indicated spacing with a maximum cumulative error of 1/8 inch.

3.4 INSTALLING WOOD FURRING AND SOFFIT FRAMING

A. Install wood furring at 12 inches o.c., unless otherwise indicated.

1. Variation of spacing of individual members shall not exceed 1/8 inch, with a maximum cumulative error of 1/8 inch.

B. Frame penetration openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated.

C. Seal gypsum board ceilings against walls with acoustical sealant along perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly. Install acoustical sealant to withstand dislocation by air-pressure differential between shaft and external spaces; maintain an airtight and smoke-tight seal; and comply with ASTM C 919 requirements or with manufacturer's written instructions, whichever are more stringent.

3.5 APPLYING AND FINISHING PANELS, GENERAL

A. Gypsum Board Application and Finishing Standards: ASTM C840 and GA-216, and to form a flat, level plane to receive finish materials.

B. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Attach gypsum panels to framing provided at openings and cutouts.

F. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.

1. Space screws a maximum of 12 inches o.c. for vertical applications.

3.6 PANEL APPLICATION METHODS

A. Single-Layer Application:

1. On ceilings, apply gypsum panels at right angles to furring, unless otherwise indicated.

B. Single-Layer Fastening Methods: Screw gypsum panels to furring.

C. Exterior Soffits and Ceilings: Apply exterior gypsum soffit board panels perpendicular to supports, with end joints staggered and located over supports.

1. Install with 1/4-inch open space where panels abut other construction or structural penetrations.

2. Fasten with corrosion-resistant screws.

3.7 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

3.8 FINISHING GYPSUM BOARD ASSEMBLIES

A. Glass-Mat Gypsum Sheathing Board: Finish with DAFS according to manufacturer's written instructions for use as exposed soffit board at interior and exterior applications.

3.9 FIELD QUALITY CONTROL

A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.

1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:
    a. Installation, insulation, and leak and pressure testing of all piped systems.
    b. Installation of air-duct systems and devices.
    c. Installation of mechanical system controls.
    d. Installation of ceiling support framing.

3.10 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or mold damaged.

3.11 SITE ENVIRONMENTAL PROCEDURES

A. Waste Management: As specified in Division 1 and as follows:

1. Select panel sizes and layout panels to minimize waste; reuse cutoffs to the greatest extent possible.

END OF SECTION 09 21 16

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. Section Includes:

1. Interior portland cement plasterwork on metal lath.
2. Exterior portland cement plasterwork (stucco) on metal lath.

1.3 SUBMITTALS

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

B. Connecticut High Performance Building Submittals:

1. Recycled Content: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
   a. Include statement indicating costs for each product having recycled content.
2. VOC Content: For sealants, including printed statement of VOC content.

C. Shop Drawings: Show locations and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other work.

D. Samples for Initial Selection: For each type of factory-prepared finish coat, prepare manufacturer's color charts consisting of actual units or sections of units at least 12 inches square showing the full range of colors, textures, and patterns available for each type of finish indicated.

1. Where finish involves normal color and texture variations, include Sample sets composed of 2 or more units showing the full range of variations expected.
2. Include similar Samples of material for joints and accessories involving color selection.

E. Samples for Verification: For each type of finish coat indicated; 12 by 12 inches, prepared on rigid backing; in sets for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics.

1.4 QUALITY ASSURANCE

A. Fire-Resistance Ratings: Where indicated, provide portland cement plaster assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

B. Sound-Transmission Characteristics: Where indicated, provide portland cement plaster assemblies identical to those of assemblies tested for STC ratings per ASTM E 90 and classified according to ASTM E 413 by a qualified testing agency.

C. Mockups: Before plastering, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Locate mockups on-site in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Install mockups for each type of finish indicated.
3. Erect full thickness mockups using materials, including lath, support system, and control joints, indicated for final Work.
4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. For interior plasterwork, simulate finished lighting conditions for review of mockups.
6. Obtain Architect's approval of mockups before start of plaster Work.
7. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed portland cement plaster Work.
    a. When directed, remove mockups from Project site.
    b. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Preinstallation Conference: Conduct conference at Project site and in compliance with requirements of Division 1 Section “Project Management and Coordination.”

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver cementitious materials to Project site in original packages, containers, or bundles, labeled with manufacturer's name, product brand name, and lot number.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.

1.6 PROJECT CONDITIONS

A. Comply with ASTM C 926 and requirements specified below.

B. Cold-Weather Requirements: Provide heat and protection, temporary or permanent, as required to protect each coat of plaster from freezing for at least 24 hours after application. Distribute heat uniformly to prevent concentration of heat on plaster near heat sources; provide deflection or protective screens.

C. Warm-Weather Requirements: Protect plaster against uneven and excessive evaporation and from strong flows of dry air, both natural and artificial. Apply and cure plaster as required by climatic and job conditions to prevent dry out during cure period. Provide suitable coverings, moist curing, barriers to deflect sunlight and wind, or combinations of these, as required.

D. Interior Plasterwork: Maintain room temperatures at greater than 50 deg F for at least 48 hours before plaster application, and continuously during and after application.

1. Avoid conditions that result in plaster drying out during curing period. Distribute heat evenly; prevent concentrated or uneven heat on plaster.
2. Ventilate building spaces as required to remove water in excess of that required for hydrating plaster in a manner that prevents drafts of air from contacting surfaces during plaster application and until plaster is dry.

E. Exterior Plasterwork:

1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.

2. Apply plaster when ambient temperature is greater than 40 deg F.

3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.

F. Factory-Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

G. Protect contiguous work from soiling and moisture deterioration caused by plastering. Provide temporary covering and other provisions necessary to minimize harmful spattering of plaster on other work.

PART 2 - PRODUCTS

2.1 METAL LATH

A. Expanded-Metal Lath: ASTM C 847 with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.

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

a. Alabama Metal Industries Corporation; a Gibraltar Industries company.

b. CEMCO.

c. Clark Western Building Systems.

d. Dietrich Metal Framing; a Worthington Industries company.

e. MarinoWARE.

f. Phillips Manufacturing Co.

2. Recycled Content: Provide steel products with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

3. Diamond-Mesh Lath: Flat or Self-furring, as scheduled, 3.4 lb/sq. yd.

2.2 STEEL SUPPORTING FRAMING

A. Provide structural, load-bearing metal framing and supports for ceilings, soffits and walls as specified in Division 5 Section “Cold Formed Metal Framing.”

2.3 ACCESSORIES

A. General: Comply with ASTM C 1063 and coordinate depth of trim and accessories with thicknesses and number of plaster coats required.

B. Metal Accessories:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Alabama Metal Industries Corporation; a Gibraltar Industries company.
   b. CEMCO.
   c. Clark Western Building Systems.
   d. Dietrich Metal Framing; a Worthington Industries company.
   e. MarinoWARE.
   f. Phillips Manufacturing Co.
2. Foundation Weep Screed: Manufacturer's standard profile designed for use at sill plate line to form plaster stop and prevent plaster from contacting damp earth, fabricated from hot-dip galvanized-steel sheet, ASTM A 653/A 653M, G60 zinc coating.
3. Cornerite: Fabricated from metal lath with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.
4. External-Corner Reinforcement: Fabricated from metal lath with ASTM A 653/A 653M, G60, hot-dip galvanized zinc coating.
5. Cornerbeads: Fabricated from zinc or zinc-coated (galvanized) steel.
   a. Small nose cornerbead with expanded flanges; use unless otherwise indicated.
   b. Small nose cornerbead with perforated flanges; use on curved corners.
   c. Small nose cornerbead with expanded flanges reinforced by perforated stiffening rib; use on columns and for finishing masonry corners.
   d. Bull nose cornerbead, radius 3/4 inch minimum, with expanded flanges; use at locations indicated on Drawings.
6. Casing Beads: Fabricated from zinc or zinc-coated (galvanized) steel; square-edged style; with expanded flanges.
7. Control Joints: Fabricated from zinc or zinc-coated (galvanized) steel; one-piece-type, folded pair of unperforated screeds in M-shaped configuration; with perforated flanges and removable protective tape on plaster face of control joint.
8. Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; folded pair of unperforated screeds in M-shaped configuration; with expanded flanges.
9. Two-Piece Expansion Joints: Fabricated from zinc or zinc-coated (galvanized) steel; formed to produce slip-joint and square-edged reveal that is adjustable from 1/4 to 5/8 inch wide; with perforated flanges.

2.4 MISCELLANEOUS MATERIALS

A. Water for Mixing: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.

B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, 1/2 inch long, free of contaminants, manufactured for use in portland cement plaster.

C. Bonding Compound: ASTM C 932.

D. Steel Drill Screws: For metal-to-metal fastening, ASTM C 1002 or ASTM C 954, as required by thickness of metal being fastened; with pan head that is suitable for application; in lengths required to achieve penetration through joined materials of no fewer than three exposed threads.

E. Plaster Washers: 1-1/4 inch diameter zinc plated steel washers for repair of existing plaster with center hole for screw and holes in washer to promote plaster bond to washer.

F. Fasteners for Attaching Metal Lath to Substrates: Complying with ASTM C 1063 for installations indicated.

G. Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, not less than 0.0475-inch diameter, unless otherwise indicated.

H. Acoustical Sealant: As specified in Division 7 Section "Joint Sealants".

1. Provide sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

I. Acid-Etching Solution: Muriatic acid (10 percent solution of commercial hydrochloric acid) mixed 1 part to not less than 6 nor more than 10 parts water.

J. Asphalt-Saturated Felt: ASTM D 226, Type I (No. 15), nonperforated.

2.5 PLASTER MATERIALS

A. Portland Cement: ASTM C 150, Type I.

1. Color for Finish Coats: As selected by Architect from full range of available colors including custom colors.

B. Colorants for Job-Mixed Finish Coats: Colorfast mineral pigments that produce finish plaster color to match Architect's sample.

C. Lime: Special hydrated lime for finishing purposes, ASTM C 206, Type S; or special hydrated lime for masonry purposes, ASTM C 207, Type S.

D. Sand Aggregate: ASTM C 897.

1. Color for Job-Mixed Finish Coats: White.

E. Ready-Mixed Finish-Coat Plaster: Mill-mixed portland cement, aggregates, coloring agents, and proprietary ingredients.

1. Products: Subject to compliance with requirements, provide the following:

a. Bonsal American, an Oldcastle Company; Marblesil Stucco Mix.

b. QUIKCRETE; QUIKCRETE Finish Coat Stucco, No. 1201.

c. SonoWall, BASF Wall Systems, Inc.; Thoro Stucco.

d. USG Corporation; Oriental Exterior Finish Stucco.

2. Color: As selected by Architect from manufacturer's full range.

2.6 PLASTER MIXES

A. General: Comply with ASTM C 926 for applications indicated.

1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed 1 lb of fiber/cu. yd. of cementitious materials.

B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:

1. Portland Cement Mixes:

a. Scratch Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.

b. Brown Coat: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.

C. Factory-Prepared Finish-Coat Mixes: For ready-mixed finish-coat plasters, comply with manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.

B. Prepare solid substrates for plaster that are smooth or that do not have the suction capability required to bond with plaster according to ASTM C 926.

3.3 INSTALLATION, GENERAL

A. Fire-Resistance-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.

B. Sound Attenuation Blankets: Where required, install blankets before installing lath unless blankets are readily installed after lath has been installed on one side.

C. Acoustical Sealant: Where required, seal joints between edges of plasterwork and abutting construction with acoustical sealant.

3.4 INSTALLING METAL LATH

A. Expanded-Metal Lath: Install according to ASTM C 1063.

1. Partition Framing and Vertical Furring: Install flat diamond-mesh lath.

2. Flat-Ceiling and Horizontal Framing: Install flat diamond-mesh lath.

3. Curved-Ceiling Framing: Install flat diamond-mesh lath.

4. On Solid Surfaces, Not Otherwise Furred: Install self-furring, diamond-mesh lath.

3.5 INSTALLING ACCESSORIES

A. Install according to ASTM C 1063 and at locations indicated on Drawings.

B. Reinforcement for External Corners:

1. Install lath-type, external-corner reinforcement at exterior locations.

2. Install cornerbead at interior locations.

C. Control Joints: Install control joints at locations indicated on Drawings, but in no case exceeding spacings shown below:

1. As required to delineate plasterwork into areas (panels) of the following maximum sizes:

a. Vertical Surfaces: 144 sq. ft..

b. Horizontal and other Nonvertical Surfaces: 100 sq. ft..

2. At distances between control joints of not greater than 18 feet o.c.

3. As required to delineate plasterwork into areas (panels) with length-to-width ratios of not greater than 2-1/2:1.

4. Where control joints occur in surface of construction directly behind plaster.

5. Where plasterwork areas change dimensions, to delineate rectangular-shaped areas (panels) and to relieve the stress that occurs at the corner formed by the dimension change.

3.6 PLASTER APPLICATION

A. General: Comply with ASTM C 926.

1. Do not deviate more than plus or minus 1/4 inch in 10 feet from a true plane in finished plaster surfaces, as measured by a 10-foot straightedge placed on surface.

2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.

3. Provide plaster surfaces that are ready to receive field-applied finishes indicated.

B. Bonding Compound: Apply on unit masonry and concrete plaster bases.

C. Walls; Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork; 3/4-inch thickness.

1. Portland cement mixes.

D. Ceilings; Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork; 1/2 inch thick.

1. Portland cement mixes.

E. Walls; Base-Coat Mix: Scratch coat for two-coat plasterwork, 3/8 inch thick on concrete masonry.

1. Portland cement mixes.

F. Ceilings; Base-Coat Mix: Scratch coat for two-coat plasterwork, 1/4 inch thick on concrete.

1. Portland cement mixes.

G. Plaster Finish Coats: Apply to provide finish to match Architect's sample.

H. Concealed Exterior Plasterwork: Where plaster application will be used as a base for adhered finishes, omit finish coat.

I. Concealed Interior Plasterwork:

1. Where plaster application will be concealed behind built-in cabinets, similar furnishings, and equipment, apply finish coat.

2. Where plaster application will be concealed above suspended ceilings and in similar locations, finish coat may be omitted.

3. Where plaster application will be used as a base for adhesive application of tile and similar finishes, omit finish coat.

3.7 PLASTER REPAIRS

A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.

B. Existing Plaster Repair: Reanchor plaster that has detached from existing lath with flathead screws and plaster washers screwed to existing lath and framing to pull plaster tight to lath. Distribute and space screws and washers as recommended by plaster washer manufacturer.

3.8 PROTECTION

A. Remove temporary protection and enclosure of other work. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION 09 24 00

PART 1 - GENERAL

1.1 RELATED SECTIONS

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. Section includes resinous flooring system for installation over concrete floor slabs in areas indicated.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

B. Samples for Initial Selection: For each type of exposed finish required.

C. Samples for Verification: For each resinous flooring system required, 6 inches square, applied to a rigid backing by Installer for this Project.

D. Connecticut High Performance Building Submittals:

1. Recycled Content: For aggregates, documentation indicating percentages by weight of postconsumer and preconsumer recycled content.
    a. Include statement that indicates cost for each product having recycled content.
2. VOC Content: Manufacturers' product data for installation adhesive, including printed statement of VOC content.

E. Product Schedule: Use resinous flooring designations indicated in Part 2 and room designations indicated on Drawings in product schedule.

F. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

G. Material Test Reports: For each resinous flooring component.

H. Material Certificates: For each resinous flooring component, signed by manufacturer.

I. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.

1. Engage an installer who employs only persons trained and approved by resinous flooring manufacturer for applying resinous flooring systems indicated.

B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer.

Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.

C. Fire-Test-Response Characteristics: As determined by testing identical products according to NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

D. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Apply full-thickness mockups on 48-inch- square floor area selected by Architect.

2. Simulate finished lighting conditions for Architect's review of mockups.

3. Maintain mockups throughout period of installation of resinous flooring to use as a benchmark for standard of installation.

4. Remove mockups when directed by Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

B. Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 RESINOUS FLOORING, SELF LEVELING

A. Basis of Design Manufacturer: The basis of design for resinous flooring is based on products of Dur-A-Flex, Inc.: Hybri-Flex EQ System as specified below. Color and aggregate types are to establish a basis of bid. Final selection shall be made from the range of colors and aggregate types within the cost class of the specified system

1. Topping: Dur-A-Flex, Inc, Poly-Crete MD and SL aggregate.

2. Broadcast Aggregate: Dur-A-Flex, Inc. Q28-29 quartz aggregate.

3. Broadcast Coat: Dur-A-Flex, Inc. Dur-A-Glaze #4, epoxy based two-component resin.

4. Grout Coat: Dur-A-Flex, Inc Dur-A-Glaze #4, epoxy-based, two-component resin.

5. Top Coat: Dur-A-Flex, Inc. Armor Top.

B. Subject to requirements, provide the named products and resinous flooring system, or comparable products of one of the following to form a comparable resinous flooring system:

1. Sherwin-Williams.
2. Crossfield Dexotex.

C. System Components: Manufacturer's standard components that are compatible with each other and as follows:

1. Primer: As recommended by manufacturer for substrate and body coats indicated.
2. Waterproofing Membrane: As recommended by manufacturer for substrate and body coats indicated.
3. Topping: Urethane based, two component resin.
   a. Application Method: Self-leveling slurry with broadcast aggregates.
      1) Number of Coats: One.
   b. Aggregates: Colored quartz (ceramic-coated silica).
4. Broadcast Coat and Grout Coat: Epoxy based, two component resin.
5. Topcoat: UV-resistant urethane two-component resin.
   a. Type: Clear.
   b. Number of Coats: One.

D. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

1. Topping: Urethane based, two component resin.

a.	Percent Reactive:	100 %
b.	VOC content:	0 g/L
c.	Bond Strength to Concrete, ASTM D 4541:	400 psi, substrates fails
d.	Compressive Strength, ASTM C 579:	9,000 psi
e.	Tensile Strength, ASTM D 638:	2,175 psi
f.	Flexural Strength, ASTM D 790:	5,076 psi
g.	Impact Resistance @ 125 mils, MIL D-3134:	160 inch lbs; No visible damage or deterioration

2. Broadcast Coat and Grout Coat:

a.	Percent Reactive:	100 %
b.	VOC content:	<4 g/L
c.	Water Absorption, ASTM D 570:	0.04%
d.	Tensile Strength, ASTM D 638:	4000psi
e.	Coefficient of thermal expansion, ASTM D 696:	2 x 10-5 in/in/F
f.	Flammability, ASTM D-635:	Self-Extinguishing

g.	Flame Spread/ NFPA 101, ASTM E-84:		Class A
3.	Topcoat:		
a.	VOC content:		0 g/L
b.	60 Degree Gloss, ASTM D523:		75+/-5
c.	Mixed Viscosity, Brookfield 25oC:		500 cps
d.	Tensile strength, ASTM D 638:		7,000 psi
e.	Abrasion Resistance, ASTM D4060:	Gloss	Satin
	CS 17 wheel, 1,000 g load 1,000 cycles	4	8 mg loss with grit
		10	12 mg loss without grit
f.	Pot life @ 70o F 50% RH:		2 hours
g.	Full Chemical resistance:		7 days

2.2 ACCESSORY MATERIALS

A. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

B. Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated.

1. Use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 PREPARATION

A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Roughen concrete substrates as follows:

a. Shot-blast surfaces with an apparatus that abrades the concrete surface, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.

b. Comply with ASTM C 811 requirements, unless manufacturer's written instructions are more stringent.

2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.

3. Adhesion testing: Before installation of resinous flooring, at areas as directed by Architect apply 24 by 24 inch area of resinous floor and allow to cure. Perform adhesion test recommended by flooring manufacturer. Proceed with installation:

a. Only after substrates pass testing.

b. Only after remedial work required by flooring manufacturer has been performed to make substrate acceptable to flooring manufacturer to receive resinous flooring.

4. Moisture Testing: Perform tests recommended by flooring manufacturer and as follows. Proceed with installation only after substrates pass testing.

a. Perform anhydrous calcium chloride test, ASTM F 1869 so that each test area does not exceed 200 sq. ft (18.6 sq. m), and perform not less than two tests in each installation area and with test areas evenly spaced in installation areas. Proceed with application only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. of slab in 24 hours.

b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement

c. Perform plastic sheet test, ASTM D 4263. Proceed with application only after testing indicates absence of moisture in substrates.

d. Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.

5. Perform alkalinity and adhesion tests recommended by resinous floor manufacturer. Verify that concrete substrates have neutral Ph and that resinous flooring will adhere to them. Proceed with application only after substrates pass testing.

C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

E. Prepare wall base coves as directed by system manufacturer.

F. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations.

3.2 APPLICATION

A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

1. Obtain concrete test records and monitor shrinkage where resinous flooring will span control joints.

a. Where rate of shrinkage cannot be determined, widen control joint to three times the thickness of the resinous flooring. Open top of joint to t a “V” profile to create relief for continued movement.

2. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.

3. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.

4. At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations. Apply joint sealant to comply with manufacturer's written recommendations.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Apply waterproofing membrane, where indicated, in manufacturer's recommended thickness.

D. Apply reinforcing membrane to entire substrate surface.

E. Apply self-leveling slurry body coat(s) in thickness indicated for flooring system.

1. At intersection of CMU walls, make integral wall base.

a. Return body coat on wall vertically to the CMU joint greater or equal to 4”above the floor surface.

b. Cove material at floor –wall intersections and interior wall-to-wall corners to a 3/8” radius

c. At exterior right-angle wall corners, the surface tension of the material may be used to establish the radius.

F. Broadcast aggregates and, after resin is cured, remove excess aggregates to provide surface texture indicated.

G. Apply grout coat, of type recommended by resinous flooring manufacturer to fill voids in surface of final body coat and to produce wearing surface indicated.

H. Apply topcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.

3.3 FIELD QUALITY CONTROL

A. Material Sampling: Owner may at any time and any number of times during resinous flooring application require material samples for testing for compliance with requirements.

1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.

2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.

3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

3.4 CLEANING AND PROTECTING

A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 09 67 23

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 surface preparation and field painting of exposed exterior and interior items and surfaces.

1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. Related Sections include the following:

1. Division 5 Section "Factory-Applied Metal Coatings" for factory-applied primer and color coats on galvanized items indicated to receive factory-applied color finishes.
2. Division 5 Section "Structural Steel" for shop priming structural steel.
3. Division 5 Section "Metal Fabrications" for shop priming ferrous metal.
4. Division 8 Section "Steel Doors and Frames" for factory priming steel doors and frames.
5. Division 9 Section "Gypsum Board Assemblies" for surface preparation of gypsum board.

C. Refer to Division 1 Section "Contract Considerations" for unit prices and allowances applicable to the Work of this Section.

1.3 PAINTING SCOPE - GENERAL

A. Paint ALL exposed surfaces in interior and exterior locations, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard or custom-mixed colors and finishes available.

1. Painting includes field painting of items in interior and exterior locations including but not limited to the following:
    a. Exposed bare and covered pipes (including color coding).
    b. Hangers.
    c. Exposed electrical conduit.
    d. Exposed junction boxes.
    e. Exposed steel and iron supports.
    f. Surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.
    g. Exposed surfaces of electrical panels in public areas.

B. Do not paint prefinished items, concealed surfaces, finished metal surfaces and/or operating parts or electrical conductor insulation jackets.

1. Prefinished items include the following factory-finished components:
    a. Galvanized steel assemblies including but not limited to handrails, guards, bollards, and the like either specified or shown by Drawings to receive factory applied color finishes.
    b. Architectural woodwork.
    c. Metal toilet enclosure doors.
    d. Metal lockers.
    e. Finished mechanical and electrical equipment.
    f. Light fixtures.
2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
    a. Foundation spaces.
    b. Furred areas.
    c. Ceiling plenums.
    d. Utility tunnels.
    e. Pipe spaces.
3. Finished metal surfaces include the following:
    a. Anodized aluminum.
    b. Stainless steel.
    c. Chromium plate.
    d. Copper and copper alloys.
    e. Bronze and brass.
4. Operating parts include moving parts of operating equipment and the following:
    a. Valve and damper operators.
    b. Linkages.
    c. Sensing devices.
    d. Motor and fan shafts.

C. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Cabling: Do not paint, spill paint or allow overspray of paint on telephone, security, and data cables and fiber optic cables. Painting of cabling voids all applicable insulation jacket warranties and requires replacement of cabling in its entirety.

1. Removal of paint misapplied to cable by any means, mechanical or solvent is not an acceptable means of remediation.
2. Cabling which intentionally, or through negligence or by accident, has received or has been damaged by paint or paint overspray will be replaced in its entirety and in conformance with applicable TIA, IEEE, and BICSI standards.

3. Contractor will bear all charges for labor and materials required for removal and replacement of all cabling which has received or has been damaged by paint or paint overspray.

1.4 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.

2. Eggshell (low luster) refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.

3. Semi gloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.

4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.5 SUBMITTALS

A. Product Data: For each paint system indicated. Include block fillers and primers.

1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.

a. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

B. Samples for Initial Selection: For each type of finish-coat material indicated.

1. After color selection, Contractor shall furnish 8 1/2” x 11” color chips for surfaces to be coated. Bind color samples in binder and submit to the Architect.

C. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.

1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.

2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.

3. Submit three (3) Samples on the following substrates for Architect's review of color and texture only:

a. Concrete: 4-inch- square Samples for each color and finish.

b. Concrete Unit Masonry: 4-by-8-inch Samples of masonry, with mortar joint in the center, for each finish and color.

c. Painted Wood: 8-inch- square Samples for each color and material on hardboard.

d. Stained or Natural Wood: 4-by-8-inch Samples of natural- or stained-wood finish on representative surfaces.

4. Ferrous Metal: 4-inch- square Samples of flat metal and 6-inch- long Samples of solid metal for each color and finish.

D. Connecticut High Performance Building Submittals:

1. VOC Content: For paints, including printed statement of VOC content and chemical components.

2. Recycled Content: Provide data showing postconsumer and preconsumer recycled materials content of materials and fabricated items provided for this project, stated as a percentage of the materials included in these items or materials provided as part of the Work of this Section.

E. Qualification Data: For Applicator.

F. Paint Maintenance Manual: As part of the closeout submittals, provide a comprehensive listing of ALL coatings applied:

1. List for each room and area in the project all surfaces to which coatings were applied including but not limited to structural steel; miscellaneous metal fabrications; interior and exterior handrails and guards; decks; porches; stairs; equipment supports; painted exterior soffits, walls and frames; interior door, window and borrowed light frames; exterior and interior finish carpentry and architectural millwork; opaque coatings applied to interior walls, ceilings, soffits and floors; exposed electrical panels; interiors of ductwork specified to be painted; siding; trim; masonry; concrete; doors; and the like.

a. Separate rooms and areas with common coating systems may be grouped.

b. Be specific.

1) To the greatest extent possible use the same finish designation as shown by finish schedule included in Contract Documents, e.g.: P-1, P2, epoxy, etc.

2) Where finish designations are not indicated, describe fully, e.g.: paint applied to hand- and guard- rails at exterior stairs, and the like.

2. Include all opaque and transparent finishes used in this Project.

3. Include manufacturer name and manufacturer's designation for each product used.

4. List type of product used (lacquer, conversion varnish, acrylic, latex, single- and multi-component epoxy, urethane, alkyd, and the like).

5. Indicate method of application and dry film thickness.

6. Include sheen (gloss, semi-gloss, satin, low lustre and the like) and effect (filled, not filled and the like).

a. For sheen, use gloss definitions according to ASTM D 16 as specified in this Section.

7. For each coating system include, as applicable, block fillers, primers, fillers, sealers, stains, body coats, top coats and clear coats.

a. For colored coatings include base type, manufacturer's color name and color formula.

8. Include color sample of finish coat not less than 3 by 5 inches in size.

9. Include manufacturer's technical product data sheet for each product.

10. Include manufacturers' material data safety sheet (MSDS) for each product.

11. Include for each product maintenance information including but not limited to cleaning and touch-up instructions.

G. QUALITY ASSURANCE

H. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

I. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.7 PROJECT CONDITIONS

A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.

B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F.

C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.8 EXTRA MATERIALS

A. Paint: Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.

1. Quantity: Furnish Owner with an additional 5 percent, but not less than 1 gal. or 1 case, as appropriate, of each material and color applied.

B. Multicolor Wall Finish: Provide ten adhesive backed sheets of jobsite applied samples for each color blend used.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

1. Sherwin-Williams: Sherwin-Williams Co.
2. Pratt and Lambert: Pratt and Lambert; a subsidiary of Sherwin-Williams Co.
3. AkzoNobel: Akzo Nobel N. V.
4. Benjamin Moore: Benjamin Moore & Co.
5. Devoe: ICI, ICI Devoe, Devoe High Performance Coatings.
6. Glidden Professional: Glidden Professional (formerly ICI Dulux Paint Centers).
7. Surface Protection Industries Inc.
8. Pittsburgh Paints: PPG Industries, Inc.

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Recycled Content: Minimum 20 percent post-consumer recycled content for light colors; minimum 50 percent post-consumer recycled content for dark colors.

C. Toxicity/IEQ: Comply with applicable regulations regarding toxic and hazardous materials, and as specified. Paints and coatings must meet or exceed the VOC and chemical component limits of Green Seal requirements.

1. Interior paint: Comply with GS-11.
2. Exterior paint: Comply with GS-11.

D. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
2. Colors: As selected by Architect from manufacturer's full range of colors including standard colors, premium colors, or custom mixed colors to match Architect’s sample.

E. Chemical Components of Field-Applied Interior Paints and Coatings: Provide products that comply with the limits for VOC content as specified, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and the following chemical restrictions; these requirements do not apply to primers or finishes that are applied in a fabrication or finishing shop:

1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).

2. Restricted Components: Paints and coatings shall not contain any of the following:

   a. Acrolein.

   b. Acrylonitrile.

   c. Antimony.

   d. Benzene.

   e. Butyl benzyl phthalate.

   f. Cadmium.

   g. Di (2-ethylhexyl) phthalate.

   h. Di-n-butyl phthalate.

   i. Di-n-octyl phthalate.

   j. 1,2-dichlorobenzene.

   k. Diethyl phthalate.

   l. Dimethyl phthalate.

   m. Ethylbenzene.

   n. Formaldehyde.

   o. Hexavalent chromium.

   p. Isophorone.

   q. Lead.

   r. Mercury.

   s. Methyl ethyl ketone.

   t. Methyl isobutyl ketone.

   u. Methylene chloride.

   v. Naphthalene.

   w. Toluene (methylbenzene).

   x. 1,1,1-trichloroethane.

   y. Vinyl chloride.

2.3 CONCRETE UNIT MASONRY BLOCK FILLERS

A. Concrete Unit Masonry Block Filler (for use at locations except those specified to receive high performance coating system specified below): Factory-formulated high-performance latex block fillers with VOC content not to exceed 100 g/L.

1. Sherwin-Williams; PrepRite Interior/Exterior Block Filler B25W25: Applied at a dry film thickness of not less than 8.0 mils.
2. Benjamin Moore; Moorcraft Super Craft Latex Block Filler No. 285: Applied at a dry film thickness of not less than 8.1 mils.
3. Pittsburgh Paints; 6-7 SpeedHide Interior/Exterior Masonry Latex Block Filler: Applied at a dry film thickness of not less than 6.0 to 12.5 mils (0.152 to 0.318 mm).

2.4 EXTERIOR PRIMERS

10. (0.036 mm) (0.046 mm)Exterior Ferrous-Metal Primer: Factory-formulated rust-inhibitive metal primer for exterior application.

1. Sherwin-Williams; Kem Bond HS High Solids Alkyd Universal Metal Primer B50WZ0004: Applied at a dry film thickness of not less than 3.0 mils.
2. Benjamin Moore; Moore's IMC Alkyd Metal Primer No. M06: Applied at a dry film thickness of not less than 2.0 mils.
3. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 3.0 mils (0.076 mm).

B. Exterior Aluminum Primer under Acrylic Finishes: Factory-formulated acrylic-based metal primer for exterior application.

1. Sherwin-Williams; primer not required over this substrate.
2. Benjamin Moore; Moore's IMC Acrylic Metal Primer No. M04: Applied at a dry film thickness of not less than 2.0 mils.
3. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 3.0 mils (0.076 mm).

C. Exterior Aluminum Primer under Alkyd Finishes: Factory-formulated acrylic-based metal primer for exterior application.

1. Sherwin-Williams; DTM Wash Primer B71Y1: Applied at a dry film thickness of not less than 2.5 mils.
2. Benjamin Moore; Moore's IMC Acrylic Metal Primer No. M04: Applied at a dry film thickness of not less than 2.0 mils.
3. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 3.0 mils (0.076 mm).

2.5 INTERIOR PRIMERS

A. Interior Concrete and Masonry Primer: Factory-formulated alkali-resistant acrylic-latex interior primer for interior application; VOC content not to exceed 220 g/L.

1. Sherwin-Williams; PrepRite Masonry Primer B28W300: Applied at a dry film thickness of not less than 3.0 mils (0.076 mm).

2. Benjamin Moore; Moorcraft Super Spec Latex Enamel Undercoater & Primer Sealer No. 253: Applied at a dry film thickness of not less than 1.2 mils (0.030 mm).

3. Pittsburgh Paints; 6-2 SpeedHide Interior Quick-Drying Latex Sealer: Applied at a dry film thickness of not less than 1.0 mil (0.025 mm).

B. Interior Low VOC Primer: Factory formulated latex-based primer for application on new or previously painted interior gypsum board, masonry and wood; and for primed or previously painted plaster or metal and for use under low VOC acrylic topcoat; VOC content not to exceed 51 g/L.

1. Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer B28W02600: Applied at a dry film thickness of not less than 1.0 mils.

2. Benjamin Moore; Eco Spec WB Interior Latex Primer N372: applied at a dry film thickness of not less than 1.2 mils.

3. Pittsburgh Paints; 6-2 SpeedHide Interior Quick-Drying Latex Sealer: Applied at a dry film thickness of not less than 1.0 mil.

C. Interior Wood Primer for Acrylic-Enamel and Semi gloss Alkyd-Enamel Finishes: Factory-formulated alkyd- or acrylic-latex-based interior wood primer.

1. Sherwin-Williams; PrepRite Classic Interior Primer B28W101 Series: Applied at a dry film thickness of not less than 1.6 mils.

2. Benjamin Moore; Moorcraft Super Spec Alkyd Enamel Underbody and Primer Sealer No. 245: Applied at a dry film thickness of not less than 1.5 mils.

3. Glidden Professional; Prep & Prime 1020 Wall and Woodwork Acrylic Primer: Applied at a dry film thickness of not less than 1.5 mils.

4. Pittsburgh Paints; 6-855 SpeedHide Latex Enamel Undercoater: Applied at a dry film thickness of not less than 1.0 mil (0.025 mm).

D. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive alkyd-based metal primer; VOC content not to exceed 450 g/L.

1. Sherwin-Williams; Kem Bond HS B50W24: Applied at a dry film thickness of not less than 3.0 mils.

2. Benjamin Moore; Moore's IMC Alkyd Metal Primer No. M06: Applied at a dry film thickness of not less than 2.0 mils.

3. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than.

E. Interior Zinc-Coated Metal Primer: Factory-formulated galvanized metal primer; VOC content not to exceed 200 g/L.

1. Sherwin-Williams; Pro Cryl B66W310: Applied at a dry film thickness of not less than 3.0 mils.

2. Benjamin Moore; Moore's IMC Acrylic Metal Primer No. M04: Applied at a dry film thickness of not less than 2.0 mils.

3. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 3.0 mils.

2.6 EXTERIOR FINISH COATS

A. Exterior Semi-Gloss High Performance Acrylic Coating: Factory-formulated one component high performance acrylic coating for application to primed metal, VOC content not to exceed 100 g/L.

1. Sherwin Williams Sher-Cryl HPA, semi gloss B66W00351: Applied at a dry film thickness of not less than 3.3 mils (0.084 mm), or comparable product by the following:

   a. Benjamin Moore.

   b. Pittsburgh Paints.

B. Exterior Acrylic Adhesion Coating: Factory-formulated one component adhesion promoting acrylic coating for direct application to previously finished aluminum surfaces, VOC component not to exceed 100 g/L.

1. Sherwin Williams Bond-Plex Acrylic B71W00211: Applied at a dry film thickness of not less than 3.0 mils (0.076 mm), or comparable product by the following:

   a. Benjamin Moore.

   b. Pittsburgh Paints.

C. Exterior Low-Luster Acrylic Paint: Factory-formulated low-sheen (eggshell) acrylic-latex paint for exterior application.

1. Sherwin-Williams; A-100 Exterior Latex Satin House & Trim Paint A82 Series: Applied at a dry film thickness of not less than 1.5 mils.

2. Benjamin Moore; Moorcraft Super Spec Low Lustre Latex House Paint No. 185: Applied at a dry film thickness of not less than 1.0 mil.

3. Pittsburgh Paints; 6-2000 Series SpeedHide Exterior House & Trim Satin--Acrylic Latex: Applied at a dry film thickness of not less than 1.0 mil.

D. Exterior Semi gloss Acrylic Enamel: Factory-formulated semi gloss waterborne acrylic-latex enamel for exterior application.

1. Sherwin-Williams; Kem Bond HS B50W24: Applied at a dry film thickness of not less than 3.0 mils.

2. Benjamin Moore; Moorcraft Super Spec Latex House & Trim Paint No. 170: Applied at a dry film thickness of not less than 1.1 mils.

3. Pittsburgh Paints; 6-900XI Series SpeedHide Exterior Acrylic Latex Semi-Gloss: Applied at a dry film thickness of not less than 1.4 mils.

E. Exterior Full-Gloss Alkyd Enamel: Factory-formulated full-gloss alkyd enamel for exterior application.

1. Sherwin-Williams; Industrial Enamel B-54 Series: Applied at a dry film thickness of not less than 2.0 mils.

2. Benjamin Moore; Moore's IMC Urethane Alkyd Enamel M22: Applied at a dry film thickness of not less than 2.0 mils.

3. Pittsburgh Paints; 7-814 Pittsburgh Paints Industrial Gloss-Oil Interior/Exterior Enamel: Applied at a dry film thickness of not less than 1.5 mils.

2.7 INTERIOR FINISH COATS

A. Interior Low Odor, Low VOC Low-Luster (Eggshell) Acrylic: Factory-formulated flat latex-based interior paint; VOC content not to exceed 11 g/L.

1. Sherwin-Williams; ProMar 200 Zero VOC Interior Latex Low Sheen Wall Paint B24W2651 Series: Applied at a dry film thickness of not less than 1.7 mils
2. Benjamin Moore; Ultra Spec 500 Interior Eggshell N537: Applied at a dry film thickness of not less than 1.8 mils.
3. Pittsburgh Paints; 6-400 Series SpeedHide Eggshell Acrylic Latex Enamel: Applied at a dry film thickness of not less than 1.25 mils.

B. Interior Low Odor, Low VOC Semi-Gloss Acrylic: Factory-formulated semi-gloss latex-based interior paint; VOC content not to exceed 11 g/L.

1. Sherwin-Williams; Pro Industrial Zero VOC Acrylic Semi-Gloss Wall Paint B66W650 Series: Applied at a dry film thickness of not less than 3.2 mils.
2. Benjamin Moore; Ultra Spec 500 Latex Semi-Gloss Enamel No. N539: Applied at a dry film thickness of not less than 1.8 mils.
3. Pittsburgh Paints; 6-4510XL SpeedHide Zero VOC Latex Semi-Gloss: Applied at a dry film thickness of not less than 1.3 mils.

C. Interior Full-Gloss Acrylic Enamel: Factory-formulated full-gloss acrylic-latex interior enamel; VOC content not to exceed 150 g/L.

1. Sherwin-Williams; ProMar 200 Interior Latex Gloss Enamel B21W201: Applied at a dry film thickness of not less than 1.5 mils.
2. Benjamin Moore; Ultra Spec 500 Acrylic Gloss Enamel No. N540: Applied at a dry film thickness of not less than 1.8 mils.
3. Pittsburgh Paints; 6-8534 Series SpeedHide Interior / Exterior 100% Acrylic Gloss: Applied at a dry film thickness of not less than 1.2 mils.

D. Interior (EP-1) Semi-Gloss Precatalyzed Acrylic Epoxy: Factory-formulated semi-gloss single-component precatalyzed waterborne acrylic epoxy; VOC content not more than 150 g/L.

1. Sherwin-Williams; K46-150 pre-catalyzed water-borne acrylic epoxy, applied at a dry film thickness of not less than 1.5 mils (0.038 mm).
2. Benjamin Moore, Corotech; Pre-Catalyzed Water-Borne Epoxy Eggshell V341, applied at a dry film thickness of not less than 1.7 mils.
3. Pittsburg Paints; PITT-GLAZE WB1 16-510 pre-catalyzed water-borne acrylic epoxy, applied at a dry film thickness of not less than 1.5 mils (0.038 mm).
4. Benjamin Moore; Latex Floor and Patio Low Sheen Enamel N122 epoxy-modifyed acrylic floor enamel applied at a dry film thickness of 1.0 mils..
5. Pittsburg Paints; PPG Floor and Porch 3-510- 100% urethane modified acrylic latex applied at a dry film thickness of 1 mils.

2.8 POLYURETHANE / ACRYLIC METALLIC PAINT

A. Coating System: Water-based, metallic factory-formulated coating system as follows:

1. General: Provide primer, base coat and top coat, all products of the same manufacturer, all mutually compatible, and all recommended for use as a coating system by the manufacturer for application to the substrate indicated.

2. Primer: Primer recommended by coating manufacturer and compatible with polyurethane acrylic base coat provided under requirements of this Section for locations and substrates indicated, and products of one of the following:

   a. Master Coating Technologies.

   b. Crescent Bronze.

   c. Precision Coatings.

3. Base Coat: Water-based polyurethane/acrylic base coat and cross-linker with VOC content not to exceed 130 g/L.

   a. Basis of Design: Master Coating Technologies: "Scuffmaster MC2000" applied at a rate of one gallon per 200 square feet of surface to be covered.

      1) Color as scheduled; refer to Drawings.

   b. Subject to compliance with requirements, provide the named basis of design product or one of the following as scheduled:

      1) Crescent Bronze: 10503 Acrylic Latex metallic Base.

      2) Precision Coatings: PC6 Waterborne Urethane Metallic.

4. Clear Coat: Water-based polyurethane protective clear coat with cross-linker and VOC content not to exceed 130 g/L.

   a. Basis of Design: Master Coating Technologies "Scuffmaster Ultra-Clear Satin" applied at a rate of one gallon per 400 square feet of surface to be covered.

   b. Subject to compliance with requirements, provide the named basis of design product or a comparable product of one of the following manufacturers, and compatible with polyurethane / acrylic metallic base coat specified by this Section.

      1) Crescent Bronze.

      2) Precision Coatings.

2.9 EXTERIOR HIGH-PERFORMANCE COATING SYSTEMS

A. Ferrous Metal: Provide the following finish systems over exterior ferrous-metal surfaces at locations indicated:

1. Semi gloss Finish: One finish coat over an intermediate coat and a primer.

   a. Primer: Acrylic primer applied at spreading rate recommended by manufacturer.

      1) S-W: Kem Kromik Universal Metal Primer B50Z Series.

      2) ICI: Devflex 4020 DTM Flat Waterborne Primer and Finish.

      3) Pittsburgh Paints: 90-7XX Series Pitt-Tech One Pack Interior/Exterior Primer Finish DTM Industrial Enamel.

   b. Intermediate Coat: Semi gloss acrylic enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 1.5 to 4.0 mils.

1) S-W: DTM Acrylic Semi-Gloss Coating B66W200 Series.

2) ICI: Devflex 4206 Interior/Exterior Waterborne Acrylic Semi-Gloss Enamel.

3) Pittsburgh Paints: 90-4XX Series Pitt-Tech One Pack Interior/Exterior High Performance Waterborne Satin DTM Industrial Enamels.

c. Topcoat: Semi gloss acrylic enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 1.5 to 4.0 mils.

1) S-W: DTM Acrylic Semi-Gloss Coating B66W200 Series.

2) ICI: Devflex 4206 Interior/Exterior Waterborne Acrylic Semi-Gloss Enamel.

3) Pittsburgh Paints: Pitt-Tech One Pack Interior/Exterior 90-4XX Series High Performance Waterborne Satin DTM Industrial Enamels.

B. Nonferrous Metal: Provide the following finish systems over exterior nonferrous-metal surfaces at locations indicated:

1. Semi gloss Finish: One finish coat over an intermediate coat and a primer.

a. Primer: Acrylic primer applied at spreading rate recommended by manufacturer.

1) S-W: DTM Wash Primer B71Y1.

2) ICI: Devflex 4020 DTM Flat Interior/Exterior Waterborne Primer and Finish.

3) Pittsburgh Paints: 90-7XX Series Pitt-Tech One Pack Interior/Exterior Primer Finish DTM Industrial Enamel.

b. Intermediate Coat: Unless otherwise indicated, acrylic enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 1.5 to 4.0 mils.

1) S-W: DTM Acrylic Semi-Gloss Coating B66W200 Series.

2) ICI: Devflex 4206 Interior/Exterior Waterborne Acrylic Semi-Gloss Enamel.

3) Pittsburgh Paints: 90-4XX Series Pitt-Tech One Pack Interior/Exterior High Performance Waterborne Satin DTM Industrial Enamels.

c. Topcoat: Semi gloss acrylic enamel applied at spreading rate recommended by manufacturer to achieve a dry film thickness of 1.5 to 4.0 mils.

1) S-W: DTM Acrylic Semi-Gloss Coating B66W200 Series.

2) ICI: Devflex 4206 Interior/Exterior Waterborne Acrylic Semi-Gloss Enamel.

3) Pittsburgh Paints: 90-4XX Series Pitt-Tech One Pack Interior/Exterior High Performance Waterborne Satin DTM Industrial Enamels.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application. Comply with procedures specified in PDCA P4.

1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. SP-1: Clean all surfaces to be coated, with Benjamin Moore M83 Oil and Grease Emulsifier, or suitable cleaning solution.

2. SP-2: Spot prime bare substrate.

3. Bonding Primers: Scuff sand hard glossy surfaces to receive bonding primer as recommended by manufacturer to roughen surface. Clean surfaces of foreign surfaces using cleaners that will not leave oily residues. Determine pH and moisture content of surfaces to receive bonding primer; do not apply bonding primer to surfaces that are not acceptable according to manufacturer’s requirements.

4. Provide barrier coats over incompatible primers or remove and reprime.

5. Cementitious Materials: Prepare concrete, concrete unit masonry; cement plaster; and mineral-fiber-reinforced cement panel, siding and trim surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.

b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.

c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.

6. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

   a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.

   b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and back sides of wood, including cabinets, counters, cases, and paneling.

   c. If transparent finish is required, backprime with spar varnish.

   d. Backprime paneling on interior partitions where masonry, plaster, or other wet wall construction occurs on back side.

   e. Seal tops, bottoms, and cutouts of unprimed wood doors with a heavy coat of varnish or sealer immediately on delivery.

   f. Sand existing wood to receive transparent finish down to bare wood (remove existing finishes) and finish same as new wood with transparent finish.

7. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations, and which are recommended, in writing, by coating manufacturer.

   a. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.

   b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.

   c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.

8. Factory-Primed Galvanized Surfaces: Prepare and prime galvanized surfaces to receive factory-applied metal coatings and primer as specified in Division 5 Section “Factory-Applied Metal Coatings.”

D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.

2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.

3. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. General: Apply paints and coatings according to manufacturer's written instructions. Use techniques and applicators including but not limited to brush, roller and spray, best suited for substrate and material being applied, and as follows:

1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
4. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
5. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
6. Provide finish coats that are compatible with primers used.
7. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
8. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
9. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
10. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
11. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
12. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
13. Sand lightly between each succeeding enamel or varnish coat.

B. Application to Metal: All paint applied to steel or other metal items including but not limited to structural steel, metal deck, bollards, corner guards, ladders, steel stairs, metal gates, miscellaneous metal items, hollow metal frames, hollow metal doors, painted metal hand rails and guards shall be spray applied.

C. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer over metal surfaces that have been shop primed and touchup painted.
3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces, and exposed exterior locations.

1. Mechanical items to be painted include, but are not limited to, the following:
   a. Uninsulated metal piping in interior and exterior locations.
   b. Uninsulated plastic piping in interior and exterior locations.
   c. Pipe hangers and supports in interior and exterior locations.
   d. Tanks in interior and exterior locations that do not have factory-applied final finishes.
   e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
   f. Duct, equipment, and pipe insulation in interior and exterior locations having "all-service jacket" or other paintable jacket material.
   g. Mechanical equipment in interior and exterior locations that is indicated to have a factory-primed finish for field painting.
2. Electrical items to be painted include, but are not limited to, the following:
   a. Switchgear in exterior and interior locations.
   b. Panelboards in exterior and interior locations.
   c. Electrical equipment in interior and exterior locations that is indicated to have a factory-primed finish for field painting.

F. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

G. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others.

Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

H. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Provide a finish free of cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections.

I. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

J. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 FIELD QUALITY CONTROL

A. Owner reserves the right to invoke the following test procedure at any time and as often as Owner deems necessary during the period when paint is being applied:

1. Owner will engage a qualified independent testing agency to sample paint material being used. Samples of material delivered to Project will be taken, identified, sealed, and certified in the presence of Contractor.

2. Testing agency will perform appropriate tests for the following characteristics as required by Owner:

a. Film thickness.

b. Paint composition.

c. Gloss.

3. Owner may direct Contractor to stop painting if test results show material being used does not comply with specified requirements. Contractor shall remove noncomplying paint from Project site, pay for testing, and repaint surfaces previously coated with the noncomplying paint. If necessary, Contractor may be required to remove noncomplying paint from previously painted surfaces if, on repainting with specified paint, the two coatings are incompatible.

3.5 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.6 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.

1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.7 SITE ENVIRONMENTAL PROCEDURES

A. Waste Management: As specified in Division 1 and as follows:

1. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product. Close and seal all partially used containers of paint to maintain quality as necessary for reuse.

3.8 INTERIOR PAINT SCHEDULE

A. Concrete Unit Masonry: Provide the following finish system over interior concrete masonry scheduled to receive epoxy:

1. Semi-Gloss, Single-Component Precatalyzed Acrylic Epoxy Finish: One finish coat over one intermediate coat over block filler.

B. Gypsum Board: Provide the following finish system over interior gypsum board scheduled to receive epoxy:

1. Low-Luster Single-Component Precatalyzed Acrylic Epoxy Finish: One finish coat over one intermediate coat and primer.

2. .

C. Ferrous Metal: Provide the following finish system over ferrous metal:

1. Semi gloss Alkyd-Enamel Finish: Two finish coats over a primer.

D. Zinc-Coated Metal: Provide the following finish system over interior zinc-coated metal surfaces:

1. Semi gloss Alkyd-Enamel Finish: Two finish coats over primer for galvanized metal.

E. All-Service Jacket over Insulation: Provide the following finish system on cotton or canvas insulation covering:

1. Flat Acrylic Finish: Two finish coats. Add fungicidal agent to render fabric mildew proof.

END OF SECTION 09 91 00

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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 direct-applied finish system.

1.3 DEFINITIONS

A. DEFS: Direct-Applied Exterior Finish System.

1.4 PERFORMANCE REQUIREMENTS

A. DEFS Performance: Comply with the following:

1. Bond Integrity: Free from bond failure within DEFS components or between system and supporting wall construction, resulting from exposure to fire, wind loads, weather, or other in-service conditions.

2. Weathertightness: Resistant to water penetration from exterior into DEFS and assemblies behind it or through them into interior of building that results in deterioration of thermal-insulating effectiveness or other degradation of DEFS and assemblies behind it, including substrates, supporting wall construction, and interior finish.

B. DEFS: Provide DEFS having physical properties and structural performance that comply with the following when tested per methods referenced:

1. Abrasion Resistance: Sample consisting of DEFS mounted on 1/2-inch- (12.7-mm-) thick gypsum board; cured for a minimum of 28 days; and showing no cracking, checking, or loss of film integrity after exposure to 528 quarts (500 L) of sand when tested per ASTM D 968, Method A.

2. Accelerated Weathering Characteristics: Sample of size suitable for test equipment and consisting of DEFS on 1/2-inch- (12.7-mm-) thick gypsum board; cured for 28 days; and showing no cracking, checking, crazing, erosion, rusting, blistering, peeling, or delamination after testing for 2000 hours when viewed under 5 times magnification per ASTM G 23, Method 1 and ASTM G 53.

3. Absorption-Freeze Resistance: No visible deleterious effects and negligible weight loss after 60 cycles per EIMA 101.01.

4. Mildew Resistance of Finish Coat: Sample applied to 2-by-2-inch (50.8-by-50.8-mm) clean glass substrate, cured for 28 days, and showing no growth when tested per ASTM D 3273.

5. Salt-Spray Resistance: Sample consisting of DEFS mounted on 1/2-inch- (12.7-mm-) thick gypsum board; cured for 28 days; and showing no cracking, checking, crazing, erosion, rusting, blistering, peeling, or delamination after testing for 300 hours per ASTM B 117.

6. Tensile Adhesion: No failure in the base coat or finish coat. Minimum 5-psi (34.5-kPa) tensile strength before and after freeze-thaw and accelerated weathering tests per EIMA 101.03.

7. Water Penetration: Sample consisting of DEFS mounted on 1/2-inch- (12.7-mm-) thick gypsum board, cured for 28 days, and showing no water penetration into the plane of the base coat to gypsum board interface of the test specimen after 15 minutes at 6.24 lbf/sq. ft. (299 Pa) of air pressure difference or 20 percent of positive design wind pressure, whichever is greater, across the specimen during a test period when tested per EIMA 101.02.

8. Water Resistance: Sample consisting of DEFS mounted on 1/2-inch- (12.7-mm-) thick gypsum board; cured for 28 days; and showing no cracking, checking, crazing, erosion, rusting, blistering, peeling, or delamination after testing for 14 days per ASTM D 2247.

1.5 SUBMITTALS

A. Product Data: For each type and component of DEFS indicated.

B. Connecticut High Performance Building Submittals:

1. Recycled Content: Provide data showing postconsumer and preconsumer recycled materials content of materials and fabricated items provided for this project, stated as a percentage of the materials included in these items or materials provided as part of the Work of this Section.

2. Regional Materials: Provide data showing materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.

C. Samples for Verification: 24-inch- (600-mm-) square panels for each type of finish-coat color and texture indicated, prepared using same tools and techniques intended for actual work.

D. Manufacturer Certificates: Signed by manufacturers certifying that DEFS and joint sealants comply with requirements.

E. Qualification Data: For Installer.

F. Maintenance Data: For DEFS to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An installer who is certified in writing by DEFS manufacturer as qualified to install manufacturer's system using trained workers.

B. Source Limitations: Obtain DEFS through one source from a single DEFS manufacturer and from sources approved by DEFS manufacturer as compatible with system components.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original, unopened packages with manufacturers' labels intact and clearly identifying products.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Maintain ambient temperatures above 40 deg F (4.4 deg C) for a minimum of 24 hours before, during, and after adhesives or coatings are applied. Do not apply DEFS adhesives or coatings during rainfall. Proceed with installation only when existing and forecasted weather conditions and ambient outdoor air and substrate temperatures permit DEFS to be applied, dried, and cured according to manufacturers' written instructions and warranty requirements.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Finish-Coat Materials: DEFS manufacturer's siliconized acrylic-based coating applied in number of finish coats required by manufacturer to produce desired finish, and complying with the following requirements for material composition and method of combining materials:

1. Factory-mixed formulation of polymer-emulsion binder, colorfast mineral pigments, sound stone particles, and fillers.
2. Products:
    a. Sto Corp.StoQuik Gold System, “Limestone” finish;
    b. Senergy, Inc.; “Senerflex.”
    c. Dryvit “Textured Acrylic Finishes.”
3. Color: As selected by Architect from manufacturer's full range of standard and premium colors, and custom colors.
4. Finish Texture: Limestone texture by Sto Corp. simulating natural limestone applied in two coats, or comparable finish by other manufacturers specified.

B. Primer: DEFS manufacturer's standard factory-mixed elastomeric-polymer primer for preparing base-coat surface for application of finish coat.

C. Base-Coat Materials: DEFS manufacturer's standard mixture complying with the following requirements for material composition and method of combining materials:

1. Job-combined formulation of water and manufacturer's standard dry mix containing Portland cement.
2. Products:
    a. Sto “230 Concrete Coating Sand.”
    b. Senergy “ALPHA BASE.”
    c. Dryvit “Sandblast.”

D. Reinforcing Mesh: Balanced, alkali-resistant, open-weave glass-fiber mesh treated for compatibility with other DEFS materials, made from continuous multiend strands with retained mesh tensile strength of not less than 120 lbf/in. (21 dN/cm) per EIMA 105.01, complying with ASTM D 578 and the following requirements for minimum weight:

1. Standard-Impact Reinforcing Mesh: Not less than 4.5 oz./sq. yd.

E. Primer/Sealer: DEFS manufacturer's standard substrate conditioner designed to seal substrates from moisture penetration and to improve the bond between substrate of type indicated and adhesive used for application of insulation.

F. Water: Potable.

2.2 MIXING

A. General: Comply with DEFS manufacturer's requirements for combining and mixing materials. Do not introduce admixtures, water, or other materials except as recommended by DEFS manufacturer. Mix materials in clean containers. Use materials within time period specified by DEFS manufacturer or discard.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of DEFS.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect contiguous work from moisture deterioration and soiling caused by application of DEFS. Provide temporary covering and other protection needed to prevent spattering of exterior finish coats on other work.

B. Protect DEFS, substrates, and wall construction behind them from inclement weather during installation. Prevent penetration of moisture behind DEFS and deterioration of substrates.

C. Prepare and clean substrates to comply with DEFS manufacturer's written requirements to obtain optimum bond between substrate and adhesive for insulation.

1. Concrete Substrates: Provide clean, dry, neutral-pH substrate for application of DEFS. Verify suitability of substrate by performing bond and moisture tests recommended by DEFS manufacturer.

3.3 DEFS INSTALLATION

A. Primer/Sealer: Where required by DEFS manufacturer, apply primer/sealer in conformance with manufacturer’s written instructions.

B. Base Coat: Apply to exposed surfaces of insulation in minimum thickness recommended in writing by DEFS manufacturer, but not less than 1/8-inch (3.2-mm) dry-coat thickness.

C. Reinforcing Mesh: Embed reinforcing mesh in wet base coat to produce wrinkle-free installation with mesh continuous at corners and overlapped not less than 2-1/2 inches (64 mm) or otherwise treated at joints to comply with ASTM C 1397 and DEFS manufacturer's written requirements. Do not lap reinforcing mesh within 8 inches (204 mm) of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are not visible.

D. Primer: Apply over dry base coat according to DEFS manufacturer's written instructions.

E. Finish Coat: Apply over dry primer, maintaining a wet edge at all times for uniform appearance, in thickness and number of coats of finish materials required by DEFS manufacturer to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.

3.4 CLEANING AND PROTECTION

A. Remove temporary covering and protection of other work. Promptly remove coating materials from window and door frames and other surfaces outside areas indicated to receive DEFS coatings.

B. Provide final protection and maintain conditions, in a manner acceptable to Installer and DEFS manufacturer that ensure that DEFS is without damage or deterioration at time of Substantial Completion.

END OF SECTION 09 97 33

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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 Markerboards.

B. Related Sections include the following:

1. Division 1 Section "Warranties and Bonds" for warranty requirements applicable to the Work of this Section.
2. Division 6 Section "Miscellaneous Carpentry" for blocking at support locations of work provided in this section.
3. Division 9 Section "Gypsum Board Assemblies" for wall construction supporting the work of this section.

1.3 SUBMITTALS

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

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Show location of panel joints.
2. Show location of special-purpose graphics for visual display surfaces.
3. Include sections of typical trim members.

C. Samples for Initial Selection: For each type of visual display surface indicated and as follows:

1. Actual sections of porcelain-enamel face sheet.
2. Sample of dry erase wall covering.
3. Samples of accessories involving color selection.

D. Samples for Verification: For each type of visual display surface indicated and as follows:

1. Visual Display Surface: Not less than 8-1/2 by 11 inches, mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.
2. Trim: 6-inch- (152-mm-) long sections of each trim profile.
3. Accessories: Full-size Sample of each type of accessory.

E. Qualification Data: For Installer.

F. Maintenance Data: For visual display surfaces to include in maintenance manuals.

G. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of visual display surface through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of visual display surfaces and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver factory-built visual display boards, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefit components at the factory, disassemble for delivery, and make final joints at the site.

B. Store visual display units vertically with packing materials between each unit.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

B. Field Measurements: Verify dimensions by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 WARRANTY

A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Surfaces lose original writing and erasing qualities.

b. Surfaces become slick or shiny.

c. Surfaces exhibit crazing, cracking, or flaking.

d. Distortion due to failure of substrate due to thermal or moisture stress.

2. Warranty Period: As specified in Section 017830 “Warranties and Bonds.”

PART 2 - PRODUCTS

2.1 MARKERBOARD ASSEMBLIES

A. Basis of Design Product: The basis of design for markerboards is Claridge Products & Equipment, Inc.; LCS Markerboard. Subject to compliance with requirements, provide either the named product or a comparable product by one of the following:

1. Manufacturers:
    a. AARCO Products, Inc.
    b. EverWhite, Menomonee Falls, Wisconsin.
    c. Moore Co, Inc.
    d. PolyVision Corporation.

B. Materials, General:

1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
2. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A60 metallic coating.
3. Extruded Aluminum: ASTM B 221, Alloy 6063.

C. Porcelain-Enamel Face Sheet: Porcelain-enamel-clad, ASTM A 463/A 463M, Type 1, stretcher-leveled aluminized steel, 0.0236-inch uncoated thickness; with porcelain-enamel coating fused to steel at approximately 1000 deg F.

1. Gloss Finish: Low gloss; dry-erase markers wipe clean with dry cloth or standard eraser. Suitable for use as projection screen.

D. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- thick, extruded aluminum; of size and shape indicated.

1. Factory-Applied Trim: Manufacturer's standard.

E. Accessories:

1. Chalktray: Manufacturer's standard and continuous in one piece.
    a. Box Type: Extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.
2. Paper Holder: Extruded aluminum; designed to hold paper by clamping action.
3. Markers and Cleaning Erasers/Cloths:
    a. Dry Erase Marker Set including red, blue, green and black.
4. Reusable dry erase marking board cleaning eraser or cloth.

F. Aluminum Finishes

1. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

3. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

4. Class II, Clear Anodic Finish: AA-M12C22A31 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class II, clear coating 0.010 mm or thicker) complying with AAMA 611.

G. Fabrication

1. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.

2. Aluminum Frames and Trim: Fabricate pieces of aluminum frames and trim in straight single pieces with no joints in straight runs of trim. Miter corners to neat, hairline closure, flush and smooth to the touch.

a. Factory install trim with units of trim neatly joined and aligned.

b. Factory applied trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance.

B. Examine walls and partitions for proper backing for visual display surfaces.

C. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.

D. Examine walls and partitions for plumbness of wall and flatness of surface.

E. Correct unsatisfactory conditions, and proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove dirt, scaling paint, projections, and depressions that will affect smooth, finished surfaces of visual display boards.

B. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, and substances that will impair bond between visual display boards and surfaces.

1. Seal wall surfaces indicated to receive visual display fabric.

3.3 INSTALLATION, GENERAL

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

1. Mounting Height: As shown by drawings.

3.4 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY UNITS

A. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches o.c. Install visual display surface into clips and onto wall. Secure board firmly to wall at both top and bottom of visual display surface according to manufacturer's printed instructions.

1. Install tight to wall with minimal gap between visual display unit and wall.

2. Where panels are joined, joint shall be tight, flush and smooth to the touch with no visible gaps.

3.5 CLEANING AND PROTECTION

A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.

B. Touch up factory-applied finishes to restore damaged or soiled areas.

C. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION 10 11 00

(B L A N K P A G E)

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. Panel signs including ADA signage, building identification signage, Code required signage, and room identification signage.
2. Signage accessories.

B. Related Sections include the following:

1. Division 1 Section "Temporary Facilities and Controls" for temporary project identification signs.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of sign.

B. Connecticut High Performance Building Submittals:

1. Product Data for Recycled Content: Provide data showing postconsumer and preconsumer recycled materials content of materials and fabricated items provided for this project, stated as a percentage of the materials included in these items or materials provided as part of the Work of this Section.
2. Product Data for Regional Materials: Provide data showing materials that have been extracted, harvested, or recovered, as well as manufactured, within 500 miles (800 km) of Project site. If only a fraction of a product or material is extracted/harvested/recovered and manufactured locally, then only that percentage (by weight) shall contribute to the regional value.
3. Product Data for VOC Content: For adhesives, sealants and chemical-bonding compounds, including printed statement of VOC content.

C. Shop Drawings: Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.

1. Provide message list for each sign, including large-scale details of wording, lettering, artwork, and braille layout.

D. Samples for Initial Selection: For each type of sign material indicated that involves color selection.

E. Samples for Verification: For each type of sign, include the following Samples to verify color selected:

1. Panel Signs: Full-size Samples of each type of sign required.

2. Casting: Show representative texture, character style, spacing, finish, edge and corner detail, and method of attachment.

   a. Size: 6 x 6 inches by full thickness of finished plaque.

3. Approved samples will not be returned for installation into Project.

F. Qualification Data: For Installer.

G. Maintenance Data: For signage cleaning and maintenance requirements to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.

1. Interior Code Signage: Provide signage as required by accessibility regulations and requirements of authorities having jurisdiction.

2. Provide signs in conformance with Ella T. Grasso Technical High School standards for signs including size, graphic organization, lettering style, color and arrangement.

3. Signs to be provided include, but are not limited to, the following:

   a. Illuminated Exit Signs: Refer to Division 26.

   b. Exit Identification: Provide tactile sign stating “EXIT” adjacent to each door to an egress stairway, an exit passageway and exit discharge.

   c. Signs for Accessible Spaces: Connecticut State Building Code, Americans with Disabilities Act Architectural Guidelines (ADAAG), and Uniform Federal Accessibility Standards (UFAS).

1.5 PROJECT CONDITIONS

A. Field Measurements: Where sizes of signs are determined by dimensions of surfaces on which they are installed, verify dimensions by field measurement before fabrication and indicate measurements on Shop Drawings.

1.6 COORDINATION

A. For signs supported by or anchored to permanent construction, advise installers of anchorage devices about specific requirements for placement of anchorage devices and similar items to be used for attaching signs.

1. For signs supported by or anchored to permanent construction, furnish templates for installation of anchorage devices.

B. Coordinate signage provided under requirements of this Section with signage provided under requirements of Division 10 Section “Signage” to ensure that signage is provided for all spaces and accessible equipment.

PART 2 - PRODUCTS

2.1 PANEL SIGNS

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

1. Best Sign Systems.
2. ASI Sign Systems, Inc.
3. Mohawk Sign Systems.
4. Stamprite Supersine.

B. Melamine Plastic Laminate: Manufacturer's standard.

1. Recycled Content: Minimum 80 percent post-consumer recycled content.

C. Unframed Panel Signs: Fabricate signs with edges mechanically and smoothly finished to comply with the following requirements:

1. Size: Match height and width of Owner’s reference sample.
2. Edge Condition: Match edges of Owner’s reference sample.
3. Produce smooth panel sign surfaces constructed to remain flat under installed conditions within tolerance of plus or minus 1/16 inch (1.5 mm) measured diagonally.
4. Corner Condition: Match corners of Owner’s reference sample.

D. Laminated Panels: Permanently laminate face panels to backing sheets of material; use manufacturer's standard process.

E. Graphic Content and Style: Provide sign copy that complies with requirements indicated below, for size, style, spacing, content, mounting height and location, material, finishes, and colors of signage.

1. 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 placed directly below last line of letters or numbers, except for room number signs where braille shall be placed directly behind the last number. Center letters and numbers on signs. Produce precisely formed characters with square cut edges free from burrs and cut marks.
    a. Raised-Copy Thickness: Not less than 1/32 inch.
2. Lettering Style: Helvetica Medium, upper case.
3. Letters and Numbers Sizes:
    a. Room numbers: 1-inch high.
    b. Room names: 5/8-inch high.
    c. Lettering for room usage and directional identification: 5/8-inch high.
    d. Lettering for restroom identification: 5/8-inch high.
    e. Restroom symbols: 3 inches high.

F. 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.

1. Panel Material: Opaque acrylic sheet.

2. Raised-Copy Thickness: Not less than 1/32 inch (0.8 mm).

G. Colored Coatings for Acrylic Sheet: For copy and background colors, provide Pantone Matching System (PMS) colored coatings, including inks and paints, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are nonfading for application intended.

1. Colors: Match color of characters and backgrounds of Owner’s reference sample.

H. Symbols of Accessibility: Provide 6-inch- high symbol fabricated from opaque nonreflective vinyl film, 0.0035-inch nominal thickness, with pressure-sensitive adhesive backing suitable for both exterior and interior applications.

2.2 ACCESSORIES

A. Mounting Methods: Use silicone adhesive fabricated from materials that are not corrosive to sign material and mounting surface.

B. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for installations as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.3 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Verify that items, including anchor inserts, provided under other sections of Work are sized and located to accommodate signs.

C. Examine supporting members to ensure that surfaces are at elevations indicated or required to comply with authorities having jurisdiction and are free from dirt and other deleterious matter.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Locate signs and accessories where indicated, using mounting methods of types described and in compliance with manufacturer's written instructions.

1. Install signs level, plumb, and at heights indicated, with sign surfaces free from distortion and other defects in appearance.

2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.

B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using methods indicated below:

1. Vinyl-Tape Mounting: Use double-sided foam tape to mount signs to smooth, nonporous surfaces. Do not use this method for vinyl-covered or rough surfaces.

2. Where panel signs are scheduled or indicated to be mounted on glass, provide matching plate on opposite side of glass to conceal mounting materials.

3.3 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

3.4 SIGN SCHEDULE

A. Submit schedule of signs to be provided for this project in accordance with Part 1 Article “Submittals” and coordinated with Division 10 Section “Exterior Signage.”

B. Refer to Signage Schedule on Drawings for room names and numbers, sign types, text and other pertinent information.

END OF SECTION 10 14 00

(B L A N K)

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. Section Includes:

1. Phenolic with color-matched core toilet compartments configured as toilet enclosure doors.

B. Related Sections:

1. Division 10 Section "Toilet and Bath Accessories" for toilet tissue dispensers, grab bars, and similar accessories.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Samples for Initial Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.

C. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Each type of material, color, and finish required for units, prepared on 6-inch- square Samples of same thickness and material indicated for Work.

2. Each type of hardware and accessory.

D. Product Certificates: For each type of toilet compartment, from manufacturer.

E. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."

B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.

2. Smoke-Developed Index: 450 or less.

C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities," ICC/ANSI A117.1 and the Connecticut State Building Code for toilet compartments designated as accessible.

1. Provide blocking and anchorages in walls, and install toilet compartments and urinal screens to withstand loads applied to compartments and screens and to accessories installed

on compartments including but not limited to grab bars installed as part of the work of other sections.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M.

B. Aluminum Extrusions: ASTM B 221.

C. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

D. Stainless-Steel Castings: ASTM A 743/A 743M.

2.2 PHENOLIC-CORE UNITS WITH COLOR MATCHED CORE

A. Basis of Design: The basis of design for Phenolic-Core Toilet Compartments with Color-Matched Core is General Partitions Mfg. Corp. Subject to compliance with requirements, provide the named product or comparable products by one of the following:

1. Global Steel Products Corp.
2. Accurate Partitions Corp.

B. Toilet-Enclosure Style: Jamb anchored to CMU partitions.

C. Door Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated) with color of core matching panel faces, with eased and polished edges and no-sightline system. Provide doors not less than 3/4 inch thick.

1. Recycled Content: Minimum 10 percent post-consumer recycled content

D. Jambs:

1. Height-of-door, each side, each side anchored to CMU with stainless steel bolts with tamper-resistant heads.

E. Phenolic-Panel Finish:

1. Facing Sheet Finish: One color and pattern in each room.
2. Color and Pattern: As selected by Architect from manufacturer's full range of colors and patterns, with manufacturer's standard through-color core matching panel faces.

2.3 ACCESSORIES

A. Hardware and Accessories: Standard design, heavy-duty operating hardware and accessories.

1. Material: Stainless steel.

2. Hinges: minimum 12 gage stainless steel 110degree opening, self-closing, continuous (piano style) fastened with tamper resistant fasteners. At least four fasteners shall pass through jamb and attach to anchor in CMU.

3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible. Attach with tamper resistant stainless steel fasteners.

4. Coat Hook: Stainless steel swivel hook, fasten through door with stainless steel tamper proof sex-bolts.

5. Door Bumper: Manufacturer's standard rubber-tipped bumper.

6. Door Pull: Manufacturer's standard door pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide door pull on push side and on pull side of doors at compartments designated as accessible.

   a. Provide one door pull on each face of door near the latch, not less than 26 inches and not more than 36 inches above the floor.

   b. Provide one door pull on compartment face of door 6 inches from the hinge side of the door, not less than 26 inches and not more than 36 inches above the floor.

7. Door Stops: Manufacturer’s standard vinyl coated stops to prevent door from being kicked in or out beyond stile; two each door.

B. Anchorages and Fasteners: Exposed tamperproof fasteners of stainless steel finished to match the items they are securing.. Provide sex-type bolts for through-bolt applications. .

2.4 FABRICATION

A. Door Size and Swings: Unless otherwise indicated, provide in-swinging doors for all toilet compartments. Coordinate dimensions with masonry openings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances: -Doors and jambs: 1/2 inch (25 mm).

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched.

END OF SECTION 10 21 13

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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 Toilet Room Accessories provided by the Contractor, and Accessories furnished by the Owner and installed by the Contractor.

1. Toilet, Accessories provided by the contractor include:

   a. Grab bars.

   b. Mirrors.

   d. Mop and broom holders.

2. Installation by Contractor of accessories furnished by Owner.

   a. Toilet tissue dispensers

   b. Soap dispensers

   c. Paper towel dispensers

B. Related Sections include the following:

1. Division 1 Section “Warranties and Bonds – CMR” for warranty requirements applicable to the Work of this Section.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, electrical power requirements, and finishes for each type of accessory specified.

B. Samples: For each accessory item to verify design, operation, and finish requirements.

C. Setting Drawings: For cutouts required in other work; include templates, substrate preparation instructions, and directions for preparing cutouts and installing anchoring devices.

D. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated in the Toilet and Bath Accessory Schedule and room designations indicated on Drawings in product schedule.

E. Maintenance Data: For accessories to include in maintenance manuals specified in Division 1. Provide lists of replacement parts and service recommendations.

1.4 QUALITY ASSURANCE

A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Architect.

B. Product Options: Accessory requirements, including those for materials, finishes, dimensions, capacities, and performance, are established by specific products indicated in the Toilet and Bath Accessory Schedule.

1. Products of other manufacturers listed in Part 2 with equal characteristics, as judged solely by Architect, may be provided.

1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, and to allow proper installation, adjustment, operation, cleaning, and servicing of accessories.

1. Coordinate with the Work of Division 26 Electrical sections to provide electrical service to electrically operated accessories.

B. Obtain mounting requirements for accessories to be furnished by Owner and installed by Contractor, and coordinate with the Work of this Contract to prevent delaying the Work.

C. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

A. General Warranty: Special warranty 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 Mirror Warranty: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.

1. Warranty Period: As specified in Section 017830 “Warranties and Bonds – CMR.”

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide accessories by one of the following:

1. Toilet and Bath Accessories:

a. American Specialties, Inc.

b. A & J Washroom Accessories, Inc.

c. Bobrick Washroom Equipment, Inc.

d. Bradley Corporation.

e. Kimberly-Clark

B. Products: Subject to compliance with requirements, provide one of the products indicated for each designation in the Toilet and Bath Accessory Schedule at the end of Part 3.

2.2 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Brass: ASTM B 19, leaded and unleaded flat products; ASTM B 16, rods, shapes, forgings, and flat products with finished edges; ASTM B 30, castings.

C. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, 0.0359-inch minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.

D. Galvanized Steel Sheet: ASTM A 653/A 653M, G60.

E. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.

F. Mirror Glass: ASTM C 1048 *Kind:* FT, *Condition:* A, *Type:* I, *Class:* 1, *Quality*: q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.

G. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

H. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

2.3 FABRICATION

A. General: Names or labels are not permitted on exposed faces of accessories. On interior surface not exposed to view or on back surface of each accessory, provide printed, waterproof label or stamped nameplate indicating manufacturer's name and product model number.

B. Surface-Mounted Toilet Accessories: Unless otherwise indicated, fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with continuous stainless-steel hinge. Provide concealed anchorage where possible.

C. Recessed Toilet Accessories: Unless otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors and access panels with full-length, stainless-steel hinge. Provide anchorage that is fully concealed when unit is closed.

D. Framed Glass-Mirror Units: Fabricate frames for glass-mirror units to accommodate glass edge protection material. Provide mirror backing and support system that permits rigid, tamper-resistant glass installation and prevents moisture accumulation.

1. Provide galvanized steel backing sheet, not less than 0.034 inch and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.

E. Mirror-Unit Hangers: Provide mirror-unit mounting system that permits rigid, tamper- and theft-resistant installation, as follows:

1. Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

F. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.

C. Install grab bars to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

3.3 TOILET AND BATH ACCESSORY SCHEDULE

A. Toilet room accessories (Bobrick Model Numbers except as called out otherwise)

a. Paper towel dispenser: Furnished by Owner, installed by Contractor.

b. Soap dispensers: ` Furnished by Owner, installed by Contractor.

c. Waste receptacle: B-2280 Stainless, floor standing (one each toilet room).

d. Mirrors: B-2908 minimum ¼” tempered glass, welded frame, concealed fasteners, with closed, angled back at wheelchair accessible sinkds.

e. Grab bars: B-5806.99 Concealed mount with peened non-slip 1-1/4 inch diameter gripping surface; 18 inch, 36 inch, and 42 inch lengths as indicated and located as shown. Provide blocking in wall for mounting.

f. Toilet paper dispensers: Furnished by Owner, installed by Contracto

END OF SECTION 10 28 13

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:

a. Multipurpose dry-chemical fire extinguishers for Class A, B and C fires.

2. Mounting brackets for fire extinguishers.

B. Related Sections include the following:

1. Division 1 Section “Warranties and Bonds” for warranty requirements applicable to the Work of this Section.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection cabinets.

1. Fire Extinguishers: Include rating and classification.

B. Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fire extinguishers and fire-protection cabinets through one source from a single manufacturer.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FMG.

D. Fire-Rated Fire-Protection Cabinets: Listed and labeled to comply with requirements of ASTM E 814 for fire-resistance rating of walls where they are installed.

1.5 COORDINATION

A. Coordinate size and mounting of fire-extinguishers and brackets to ensure that each type and capacity of fire extinguisher indicated is accommodated.

1.6 SEQUENCING

A. Apply decals on field-painted surfaces after painting is complete.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of portable fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.

b. Faulty operation of valves or release levers.

2. Warranty Period: As specified in Section 017830 “Warranties and Bonds.”

PART 2 - PRODUCTS

2.1 MULTIPURPOSE, DRY-CHEMICAL PORTABLE FIRE EXTINGUISHERS

A. Basis-of-Design Product: JL Industries, Inc.; Cosmic 10E with pressure gauge, or a comparable product by one of the following:

1. Manufacturers:

a. Amerex Corporation.

b. Ansul Incorporated.

c. Badger Fire Protection.

d. Buckeye Fire Equipment Company.

e. Kidde Fyrnetics.

f. Larsen's Manufacturing Company.

g. Moon American

2. General: Provide fire extinguishers of type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

3. Valves: Manufacturer's standard.

4. Handles and Levers: Manufacturer's standard.

5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4A-60-BC, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.2 MOUNTING BRACKETS

A. Manufacturers:

a. Amerex Corporation.

b. Ansul Incorporated.

c. Badger Fire Protection.

d. Buckeye Fire Equipment Company.

e. Kidde Fyrnetics.

f. Larsen's Manufacturing Company.

g. Moon American

B. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.

1. Color: Red.

C. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

a. Orientation: Vertical.

2.3 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable blocking where hangers will be installed.

B. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged units.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights indicated below:

1. Mounting Brackets: 54 inches (1372 mm) above finished floor to top of fire extinguisher.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

C. Identification: Apply lettering at locations indicated.

3.3 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, unless manufacturer's written installation instructions indicate otherwise.

B. Replace fire extinguisher mounting brackets that have been damaged.

C. Protect fire extinguishers and mounting brackets from damage and abuse until Date of Substantial Completion of the Project.

END OF SECTION 10 44 00

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. Knocked-down, athletic metal lockers.
2. Locker room benches.

B. Related Sections include the following:

1. Division 1 Section “Warranties and Bonds” for warranty requirements applicable to the Work of this Section.
2. Division 6 Section "Miscellaneous Carpentry" for furring, blocking, and shims required for installing metal lockers and concealed within other construction before metal locker installation.

1.3 DEFINITIONS

A. Uncoated Steel Sheet Thicknesses: Indicated as the minimum thicknesses.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Show base, sloping tops, filler panels, recess trim, and other trim and accessories.
2. Include locker identification system and numbering sequence.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For metal lockers and locker room benches in manufacturer's standard sizes.

E. Qualification Data: For Installer.

F. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

G. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative of metal locker manufacturer for installation and maintenance of units required for this Project.

B. Source Limitations: Obtain metal lockers and accessories through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of metal lockers and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

D. Regulatory Requirements: Where metal lockers are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." ICC A117.1. and the Connecticut State Building Code.

1. Provide not less than 1 shelf located no higher than 48 inches above the floor for forward reach.

2. Provide 1 shelf located at bottom of locker no lower than 15 inches (381 mm) above the floor for forward reach.

3. Provide hardware that does not require tight grasping, pinching, or twisting of the wrist, and that operates with a force of not more than 5 lbf (22.2 N).

E. 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. Do not deliver metal lockers and benches until spaces to receive them are clean, dry, and ready for metal locker installation.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify the following by field measurements before fabrication and indicate measurements on Shop Drawings:

1. Concealed framing, blocking, and reinforcements that support metal lockers before they are enclosed.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.

b. Faulty operation of latches and other door hardware.

2. Damage from deliberate destruction and vandalism is excluded.

3. Warranty Period: As specified in Section 017830 “Warranties and Bonds.”

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008, Commercial Steel (CS) Type B, suitable for exposed applications.

B. Fasteners: Zinc- or nickel-plated steel, slotless-type exposed bolt heads, and self-locking nuts or lock washers for nuts on moving parts.

C. Anchors: Select material, type, size, and finish required for secure anchorage to each substrate.

1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance.

2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.3 KNOCKED-DOWN, ATHLETIC METAL LOCKERS

A. Basis-of-Design Product: Republic Storage Systems Company; Heavy Duty Ventilated Lockers or a comparable product of one of the following:

1. Knocked-Down, Athletic Metal Lockers:

a. DeBourgh Mfg. Co.

b. List Industries Inc.

c. Lyon Workspace Products.

B. Locker Arrangements and Sizes:

1. At Locker Rooms:

a. Double tier at locations shown by Drawings, 15” x 18” x 30” high with continuous metal base as specified by this Section.

C. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated, cold-rolled steel sheet with thicknesses as follows:

1. Tops and Bottoms: 0.0528 inch (1.35 mm) thick, with single bend at edges.

2. Backs: 0.0428 inch (1.1 mm) thick.

3. Shelves: 0.0528 inch (1.35 mm) thick, with double bend at front and right-angle single bend at sides and back.

D. Perforated Sides: Fabricated from 0.0528-inch- (1.35-mm-) thick, cold-rolled steel sheet with manufacturer's standard diamond perforations.

E. Frames: Channel formed; fabricated from 0.0528-inch- (1.35-mm-) thick, cold-rolled steel sheet or 0.0966-inch- (2.5-mm-) thick steel angles; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.

1. Cross Frames for Double-Tier Lockers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.

F. Locker Base: Structural channels, formed from 0.0528-inch- (1.35-mm-) thick, cold-rolled steel sheet; welded to front and rear of side-panel frames.

G. Perforated Doors: One-piece, fabricated from 0.0677-inch- (1.7-mm-) thick, cold-rolled steel sheet with manufacturer's standard diamond perforations; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.

1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches (381 mm) wide; welded to inner face of doors.

H. Hinges: Self-closing; welded to door and attached to door frame with not less than 2 factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees. Provide one of the following as standard with manufacturer:

1. Continuous Hinges: Manufacturer's standard, steel continuous hinge.

I. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry resistant.

1. Multipoint Latching: Finger-lift latch control designed for use with padlocks; positive automatic and prelocking.

a. Latch Hooks: Equip doors 48 inches and higher with 3 latch hooks and doors less than 48 inches high with 2 latch hooks; fabricated from minimum 0.0966-inch- thick steel; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.

b. Latching Mechanism: Manufacturer's standard rattle-free latching mechanism and moving components isolated with vinyl or nylon to prevent metal-to-metal contact, and incorporating a prelocking device that allows locker door to be locked while door is open and then closed without unlocking or damaging lock or latching mechanism.

J. Padlocks: Not in Contract.

1. Equipment: Equip each metal locker with identification plate and one double-prong ceiling hook and two single-prong wall hooks in each locker.

K. Accessories:

1. Continuous Base: 6 inches (152 mm) high; fabricated from 0.0677-inch- (1.7-mm-) thick, cold-rolled steel sheet.

2. Continuous Sloping Tops: Fabricated from minimum 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet; approximately 20-degree pitch.

a. Closures: Hipped-end type.

3. Recess Trim: Fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet.

4. Filler Panels: Fabricated from 0.0428-inch- (1.1-mm-) thick, cold-rolled steel sheet.

5. Boxed End Panels: Fabricated from 0.0528-inch- (1.35-mm-) thick, cold-rolled steel sheet.

L. Finish: Powder coat.

1. Color(s): As selected by Architect from manufacturer's full range of standard and premium colors.

2.4 LOCKER ROOM BENCHES

A. General: Provide locker room benches fabricated by same manufacturer as metal lockers.

B. Bench Tops: Manufacturer's standard 1-piece units, of the following material, minimum 9-1/2 inches (240 mm) wide by 1-1/4 inches (32 mm) thick, with rounded corners and edges:

1. Laminated maple with one coat of clear sealer on all surfaces, and one coat of clear lacquer on top and sides.

C. Fixed Pedestals: Manufacturer's standard supports, with predrilled fastener holes for attaching bench top and anchoring to floor, complete with fasteners and anchors, and as follows:

1. Tubular Steel: 1-1/4-inch- (32-mm-) diameter steel tubing, with 0.1265-inch- (3.2-mm-) thick steel flanges welded at top and base; with baked-enamel finish; anchored with exposed fasteners.

a. Color: As selected by Architect from manufacturer's full range.

2.5 FABRICATION

A. General: Fabricate metal lockers square, rigid, and without warp; with metal faces flat and free of dents or distortion. Make exposed metal edges free of sharp edges and burrs, and safe to touch.

1. Form body panels, doors, shelves, and accessories from one-piece steel sheet, unless otherwise indicated.

2. Provide fasteners, filler plates, supports, clips, and closures as required for a complete installation.

B. Unit Principle: Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.

C. Knocked-Down Construction: Fabricate metal lockers for nominal assembly at Project site using nuts, bolts, screws, or rivets. Factory weld frame members together to form a rigid, one-piece assembly.

D. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.

E. Identification Plates: Manufacturer's standard etched, embossed, or stamped aluminum plates; with numbers and letters at least 3/8 inch high.

F. Continuous Base: Formed into channel or Z profile for stiffness, and fabricated in lengths as long as practicable to enclose base and base ends of metal lockers; finished to match lockers.

G. Continuous Sloping Tops: Fabricated in lengths as long as practicable, without visible fasteners at splice locations; finished to match lockers.

1. Sloped top corner fillers, mitered.

H. Boxed End Panels: Fabricated with 1-inch- wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.

1. Provide one-piece panels for double-row (back-to-back) locker ends.

2.6 STEEL SHEET FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.

C. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond. Use manufacturer's standard methods.

D. Finish: Either of the following:

1. Baked-Enamel Finish: Immediately after cleaning, pretreating, and phosphatizing, apply manufacturer's standard thermosetting baked-enamel finish. Comply with paint manufacturer's written instructions for application, baking, and minimum dry film thickness.

2. Powder-Coat Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard baked-polymer thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion, using concealed fasteners.

2. Anchor single rows of metal lockers to walls near top of lockers and to floor.

3. Anchor back-to-back metal lockers to floor.

B. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach hooks with at least two fasteners.

2. Identification Plates: Identify metal lockers with identification indicated on Drawings.

a. Attach plates to each locker door, near top, centered, with at least two rivets.

3. Attach filler panels with concealed fasteners. Locate fillers panels where indicated on Drawings.

4. Attach sloping top units to metal lockers, with closures at exposed ends.

5. Attach boxed end panels with concealed fasteners to conceal exposed ends of nonrecessed metal lockers.

C. Fixed Locker room benches: Provide not less than 2 pedestals for each bench, uniformly spaced not more than 72 inches (1830 mm) apart. Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding. Verify that integral latching devices operate properly.

B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit metal locker use during construction.

C. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by metal locker manufacturer.

END OF SECTION 10 51 13

(B L A N K P A G E)

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. Provide all equipment and materials, and do all Work necessary to furnish, assemble and install the athletic field equipment, (fixed and non-fixed), as indicated on the Drawings and as specified herein. Certain items shall be carried as Alternate Bid items.

B. All equipment and materials shall meet or exceed the Connecticut Interscholastic Athletic Conference (CIAC), the National Federation of State High School Associations (NFHS) and the American Sports Builders Association (ASBA) Rules and Regulations.

1.3 SUBMITTALS

A. Shop Drawings of each equipment item, including foundations and footings to be installed will be submitted for the Engineer's approval. Indicate methods for allowing each item to properly drain.

B. Catalog Cuts, manufacturer's data and manufacturer's installation instructions will be submitted on each item of non-fixed and fixed field equipment to be provided in accordance with this Specification.

1.4 PRODUCT DELIVERY AND STORAGE

A. Materials, when delivered to the site, will be stacked and stored above the ground and under protective coverings, or indoors, in such a manner as to insure proper drainage, ventilation and protection.

B. Non-fixed equipment will be delivered to the site and stored local to the project site, as directed by the Owner and/or the Engineer.

1.5 WARRANTY

A. As specified in Section 017830 "Warranties and Bonds – CMR".

PART 2 - PRODUCTS

2.1 PROTECTIVE NETTING

A. Basis of Design: Sixteen foot (16') high 4" Straight StormGuard Netting System shall be model No. TFBSS416P, or equal, as manufactured by Sportsfield Specialties, Inc., 41155 State Highway 10, Delhi, NY 13753, or comparable product from Sportedge or AAE Sports.

1. Poles shall be Schedule 40 aluminum 4" diameter black powder coated poles set in ground sleeves for removable installation. Provide 60" ground sleeves and ground sleeve caps for all ground sleeves (in pole – removed condition).

2. Netting shall be Heavy Duty, black #36 nylon 1-3/4" square mesh net with block pulley and tether system for net removal.

B. Contractor shall provide foundation shop drawings for each netting system height stamped by a registered Connecticut professional engineer.

2.2 COMBINATION FOOTBALL/SOCCER GOALS

A. Basis of Design: Combination football/soccer goals shall be Model No. SG4980HS Original GoalPak® High School Combination Football/Soccer Goal System and Accessories as manufactured by Sportsfield Specialties, Inc., 41155 State Highway 10, Delhi, NY 13753, or comparable product from Sportedge or AAE Sports.

B. Basis of Design: Football Goal Post pads shall be Model No. GP 4590RFULL by Sportsfield Specialties, Inc., 41155 State Highway 10, Delhi, NY 13753, or comparable product from Sportedge or AAE Sports.

C. Basis of Design: Football Pylons (Three sets of 4; 12 total) shall be Model No. GPEZP4 by Sportsfield Specialties, Inc., 41155 State Highway 10, Delhi, NY 13753, or comparable product from Sportedge or AAE Sports.

2.3 LACROSSE GOALS

A. Basis of Design: Lacrosse Goals (1 set) shall be Model No. LCG Lacrosse Goal Equipment and Accessories by Sportsfield Specialties, Inc., 41155 State Highway 10, Delhi, NY 13753, or comparable product from Sportedge or AAE Sports.

2.4 FIELD HOCKEY GOALS

A. Basis of Design: Field Hockey Goals (1 set) shall be Model No. FHG Field Hockey Goal Line Equipment and Accessories by Sportsfield Specialties, Inc., 41155 State Highway 10, Delhi, NY 13753, or comparable product from Sportedge or AAE Sports.

2.5 UTILITY BOXES

A. Basis of Design: Utility boxes within the area of synthetic turf shall be as manufactured by Sportsfield Specialties, Inc., 41155 State Highway 10, Delhi, NY 13753, or comparable product from Sportedge or AAE Sports. These utility boxes shall be used in lieu of utility boxes noted on the site electrical drawings or electrical specifications unless otherwise noted.

1. Electrical/Communications: Within areas of synthetic turf shall be COMBOX Plus 3500 or approved equal.

2. Water: Within areas of synthetic turf shall be Model No. TC-3700-QVC Plus Quick Connect Valve Box.

2.6 TEAM BENCHES

A. Basis of Design: Team Benches (total 6) shall be fifteen-foot-long Single Tier Portable Aluminum Plank Bench with Back Rest, standard powder coat finish as selected by owner Model No. LG-STAL-BRPT-15, as manufactured by Sportsfield Specialties, Inc., 41155 State Highway 10, Delhi, NY 13753, or comparable product from Sportedge or AAE Sports.

2.7 TEAM BENCHES BASEBALL AND SOFTBALL

A. Basis of Design: Team Benches (total 4) shall be fifteen-foot-long Single Tier Semi-permanent Aluminum Plank Bench with Back Rest, standard powder coat finish as selected by owner Model No. LG-STAL-BRPT-15, as manufactured by Sportsfield Specialties, Inc., 41155 State Highway 10, Delhi, NY 13753, or comparable product from Sportedge or AAE Sports.

2.8 BASES, HOME PLATES, PITCHING RUBBERS

A. Basis of Design: All bases (total 5, 1 double 1st base) shall be square or rectangular constructed of heavy-duty rubber with integral anchors capable of connecting to accompanying 1-inch anchors. Double 1st base shall be capable of compressing on impact.

B. Basis of Design: Home plate (total 2) shall be constructed of heavy-duty rubber with stanchion-mounted steel plate with integral ground anchors capable of connecting to accompanying 1-inch anchors.

C. Basis of Design: Pitching rubbers (total 2) shall be permanent constructed of heavy-duty highly durable rubber with PVC tube inside and be regulation size of 6” x 6” x 4”.

2.9 FENCE CAP

A. Basis of Design: Fence cap (Baseball and Softball) shall cover the entire outfield fence top and be 4-1/2” diameter, bright yellow, and fully UV protected.

PART 3 - EXECUTION

3.1 ATHLETIC FIELD EQUIPMENT

A. Install equipment at the locations indicated on the Drawings and in strict accordance with the manufacturer’s printed instructions. All non-fixed equipment will be assembled by the Contractor.

B. Equipment footings shall be installed prior to installation of surrounding pavement base or turf base stone, and any finished paving or turf.

3.2 BASE INSTALLATION

The contractor should follow the following guidelines in addition to the specific manufacturer’s installation instructions.

A. Creating concrete anchors:

1. Build three forms. Each form will require (2) 15″ long 2x4s, (2) 18″ long 2x4s, and (1) 18″ x 18″ piece of ½” plywood or OSB board. Nail, screw and/or glue the pieces together. When finished, the inside of the box should be 15″ x 15″, the same size as your base.

2. Using a chalk line or a pencil and straight edge, draw straight lines from corner to corner on the inside bottom of the form making an “X”. Center your anchor (1″ or 1 ½”) on the “X” so that the sides are parallel to the sides of the wooden form. Be sure that the flared end of the anchor is at the bottom of the form box.

3. Fill with concrete. Mix an 80 lb bag of Redi-Mix concrete as directed on the package. Have someone hold the base anchor in position. Fill the form to the top with the concrete mix and allow one day to cure.

B. Locating the base anchor positions:

1. Find the center of 2nd base; with the centerline in place, refer to the drawings for the layout of each ball field to get the correct Infield Hypotenuse dimension. Measure with a steel measuring tape from the apex of home plate (following the centerline) to the distance indicated for the Infield Hypotenuse. Place a tarp pin or nail at that spot on the centerline. This is the center of 2nd base.

2. Measure to 1st base. From the 2nd base pin the base distance (as indicated on drawings) is where 1st base will be positioned. Using a second steel tape, measure the required base distance from the point of home plate to 1st base. Where the two tape measures form a right angle, set another tarp pin or nail. This is the back foul corner of 1st base.

3. Now repeat the process to position 3rd base. From the 2nd base pin measure the proper base distance to 3rd base. Using a second tape, measure from the point of home plate to 3rd base. Where the tape measures meet to form a right angle is where you place your tarp pin. This is the back foul corner of 3rd base.

4. Make sure it's accurate. Measure the hypotenuse from the 1st base pin to the 3rd base pin. This is the same as the home plate to 2nd base hypotenuse. If these are not equal, re-measure your base locations. Once the 1st-to-3rd and home-to-2nd distances match, your base locations are accurately marked.

C. Installation of 1st and 3rd base anchors:

1. Starting at the point of home plate, run a string line up the foul edge of the foul line well past the 1st or 3rd base pin. This string line should be slightly to the foul side of your 1st or 3rd base pin.

   To be installed correctly, the base should cover the foul line as it runs under the base. Next, excavate an area about 2′ square where the base should be located. Excavate this area knowing the pins you set indicate the back foul corner of the base.

   Most metal anchors are about 8″ long and your 2′ x 2′ hole for the anchor should be 8 ½" to 8 ¾" deep. The top of the anchor post should always be ½" to ¾" below the surface so it is never caught when nail dragging. Make sure that the bottom of the hole is level and well compacted.

2. To place the anchor, remove one of the concrete anchors from its form by turning it upside down and pounding the form with a rubber mallet to loosen. Make sure that there is no concrete inside the steel anchor post. To maintain proper drainage, clear any excess concrete if necessary. Using a 2×4, create a bridge across the hole and over the anchor post. Ensure that there is a gap of 1/2″ to 3/4″ from the top of the anchor post to the bottom of your 2×4 bridge. If not, remove the anchor, correct the sub-grade, and remeasure the depth.

3. Once your depth is set, make sure the anchor is level. Use a torpedo level on the sides of the anchor post. If necessary, adjust the grade under the concrete anchor until it is level.

4. Using the string line as your guide, maneuver the anchor so one edge of the concrete is on the string line, the back foul corner of the concrete is where your pin was placed, and the rest of the concrete is on the "fair side" of your string. Measure from the point of home plate to the back foul corner of the concrete anchor to ensure correct base placement. You may place a base in the anchor to make for easier measuring. After adjusting your concrete anchor accordingly for correct placement, recheck for levelness and proper depth. Adjust if needed.

5. When all three parameters are met (distance, depth, levelness), the anchor can be buried. Add soil a few inches at a time. Compact thoroughly before adding the next few inches. Continue until the level of soil in the excavated area matches the grade of the surrounding infield skin. Compact the soil, then moisten and apply topdressing if used.

D. Installation of 2nd base anchor:

1. Dig a hole and level it out; the 2nd base pin placed marks the base's exact center. Therefore, excavating 1 foot out in all directions from the base pin will create a 2 foot square area. Follow the same process of excavation and leveling as indicated for the installation of 1st and 3rd base anchors.

2. Find the exact center of 2nd base. Place the concrete anchor in the hole. Stretch the steel measuring tapes from the back foul corners of both 1st and 3rd base toward 2nd base. The exact center of 2nd base is where the two tapes form a right angle at the proper base distance (see drawings). Center the anchor post at that point, making sure the sides of the concrete anchor are parallel to the foul lines.

3. Bury the anchor. When all three parameters are met (distance, depth and levelness), the anchor can be buried, just as you buried the 1st and 3rd base anchors.

E. Test each base, troubleshoot if necessary:

1. With the anchors now in place, test them by installing the bases to see how they sit on the infield skin surface. The base should sit flush to the skin surface with no gaps.

3.3 PITCHING RUBBER INSTALLATION

The following are the 4 key parameters that must be followed when setting the pitching rubber. The contractor should follow these guidelines in addition to the specific manufacturer's installation instructions.

A. Elevation:

1. The elevation of the pitching rubber is measured in respect to the elevation of home plate (see drawings for dimensions).

2. Use a transit or builders level to measure the height of the home plate surface and pitching rubber surface. Ensure that the correct change in elevation between the two is being used.

B. Distance:

1. The distance from the pitching mound to home plate (pitching distance) should be measured using a steel tape from the apex of the white portion of home plate to the front center of the pitching rubber. Refer to the drawings for slopes and dimensions.

C. Levelness:

1. The level should be checked in two directions on the rubber: from side to side and front to back. A torpedo level should be used for more accurate results.

2. The pitching rubber being installed should be in pristine condition. Any bubbling of the rubber will make it impossible to achieve a level pitching rubber.

D. Square:

1. To check if the pitching rubber is square to home plate; first find the center of the pitching rubber and mark it. Run a very taut string line from the apex of home plate to the center of second base. Pop the string line 3 to 5 times to see where the line settles. The string should fall on the center line of the pitching rubber.

3.4 CLEANING

A. Upon completion of the work in any given area, remove all rubbish and debris from the work area and leave it in clean condition.

END OF SECTION 11 68 33

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. Provide all equipment and materials and do all work necessary to furnish and install the track and field equipment, (fixed and non-fixed), as indicated on the Drawings and as specified herein.

B. All equipment and materials shall meet or exceed the Connecticut Interscholastic Athletic Conference (CIAC), the National Federation of State High School Associations (NFHS) and the American Sports Builders Association (ASBA) Rules and Regulations.

1.3 SUBMITTALS

A. Shop drawings of each equipment item, including foundations and footings to be installed shall be submitted for the Engineer's approval. Indicate methods for allowing each item to properly drain.

B. Catalog cuts and manufacturer's data will be submitted on each item of non-fixed track and fixed field equipment to be provided, in accordance with this specification.

1.4 PRODUCT DELIVERY AND STORAGE

A. Materials, when delivered to the site, shall be stacked and stored above the ground, under protective coverings, or indoors, in such a manner as to insure proper drainage, ventilation, and protection.

1.5 WARRANTY

A. As specified in Section 017830 “Warranties and Bonds – CMR”.

PART 2 - PRODUCTS

2.1 TRACK AND FIELD EQUIPMENT – FIXED

A. Sand Pit

1. Basis of Design: Long/Triple Jump Sand Pit and Aluminum Cover Set: Sand Pit shall be bolt together aluminum construction with dimensions 3Mx7M, with sand catchers.

2. Basis of Design: Aluminum Sand Pit Cover Set shall be sized to cover the entire sand area and designed to receive specified track surfacing. Contractor shall submit shop drawings showing compliance with the pit dimension.

3. Sand for long jump and triple jump landing zones shall be washed river sand, 0 to 2 mm graining, with no organic components, and a maximum of 5% of its weight can be up to 0.20 mm in diameter.

B. Basis of Design: Take-off Boards (4 total): Take-off Boards shall be textured polyboard with slide-on design and also be equipped with a drainage stub.

C. Basis of Design: Discus Cage: Discus Cage shall meet NFS specifications, rules, and requirements, and be equipped with 4” powder coated black aluminum poles.

D. Basis of Design: Discus Circle: Discus Circle shall be aluminum construction with stainless steel hardware.

E. Basis of Design: Shot Put: Shot Put Toe Board shall be constructed of white powder coated aluminum.

F. Basis of Design: Shot Put Circle: Shot Put Circle shall be aluminum construction with stainless steel hardware.

G. Pole Vault Box

1. Basis of Design: Pole Vault Box shall be manufactured from cast aluminum or 13 gauge, 304 stainless steel, be equipped with set wings, and compatible with the pole vault box cover.

2. Basis of Design: Pole Vault Box Cover shall consist of a retractable pull handle and a ½” recessed area to apply synthetic track materials.

3. Contractor shall provide ¾” PVC drain pipe, finish stone and fabric as shown pole vault box detail.

2.2 TRACK AND FIELD EQUIPMENT – NON-FIXED

A. Basis of Design: Protective Crossing Mat: Protective Crossing Mat (6 total) shall be 4' x 40' x 10mm Black Rollout Runway Material.

B. Basis of Design: Hurdles: Hurdles (80 total) shall be 41" width 'L' shaped powder coated aluminum and polycarbonate adjustable height hurdles. Powder coating color shall be standard red. Provide custom lettering on Gate boards stating text to be determined.

C. Basis of Design: Hurdle Carts: (8 total) shall be 41" 'L' shaped Hurdle Cart. Provide one (1) all weather vinyl cover for each cart.

D. Basis of Design: High Jump Pad and Cover: High Jump Pad shall be 18' x 10' x 28" with all-weather Cover and Ground Cover.

E. Basis of Design: High Jump Standards shall range from 2’ to 8’ and be equipped with a mounting stub and clamping collar.

F. Basis of Design: Pole Vault Pad and Cover: Pole Vault Pad shall be a silver pole vault pad landing system 19'-9" x 20'-2" x 28" NFHS. Include Weather cover, ground cover and base protector set.

G. Basis of Design: Pole Vault Standards shall be International Pole Vault Standards equipped with steel base rail, steel rolling base with brake wheels, a clamping collar, and have a minimum height of 5’ and a maximum height of 17’.

PART 3 - EXECUTION

3.1 TRACK AND FIELD EQUIPMENT

A. Install track and field equipment at locations indicated on the drawings, in strict accordance with the manufacturer's printed instructions.

3.2 CLEANING

A. Upon completion of work in any given area, remove all rubbish and debris from the work area and leave it in clean condition.

END OF SECTION 11 68 35

ISSUED for BID

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. Install an electronic LED scoreboard on concrete and steel foundation supports, as indicated on the Drawings and as specified herein. Include all testing and adjustments required and provide instructions to the Owner's Representative.

1.3 SUBMITTALS

A. Product data: Submit manufacturer's product illustrations, data and literature that fully describe the scoreboards and accessories proposed for installation. Submit a colored 2-dimensionsional rendering of actual scoreboards to be provided with all logos and text as applicable.

B. Maintenance data: Submit manufacturer's installation, operation, and maintenance manuals.

C. Foundation plans prepared and stamped by a CT licensed structural engineer.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of scoring or related equipment through one source from a single manufacturer.

B. Installed Scoreboard shall be:

1. Intended for outdoor use.
2. ETL listed to UL Standards 48 and 1433
3. NEC compliant
4. FCC compliant
5. ETLC listed to CAN/CSA 22.2

C. Installer:

1. A firm with a minimum of five (5) years of experience in the type of work required by this Section and that is acceptable to the manufacturer of the primary materials.

D. Field Measurements

1. Take all necessary field measurements before the preparation of shop drawings and fabrication. Do not delay progress of the job. If field measurements are not possible prior to fabrication, allow for field cutting and fitting.

1.5 PROJECT CONDITIONS

A. Substrates: Proceed with work only when the substrate construction and penetration work is complete.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials and products in unopened, factory labeled packages. Store and handle them in strict compliance with the manufacturer's instructions and recommendations. Store them under cover and protect from weather damage.

B. Sequence deliveries to avoid delays, but minimize on-site storage.

C. Environmental limitations: Do not install scoreboard equipment until mounting structure is secure and concrete has ample time to cure.

D. Field measurements: Verify position and elevation of structure and its layout for scoreboard equipment. Verify dimensions by field measurements.

E. Verify mounting structure is capable of supporting the scoreboard's weight and wind load in addition to the auxiliary equipment.

1.7 WARRANTY

A. Refer to Section 017830 "Warranties and Bonds – CMR".

B. Provide five (5) years advanced exchange parts warranty.

C. Provide five (5) years onsite labor warranty from local authorized dealer.

PART 2 - PRODUCTS

2.1 MULTIPURPOSE FIELD SCOREBOARD

A. Basis of Design: Scoreboard (total 1) shall be FB-2018 LED Scoreboard (8'H x 18'W) with 18" ht. red digits with top and bottom ad panels as manufactured by Daktronics, 331 32nd Avenue, P.O. Box 5128, Brookings, SD USA 57006-5128, Phone: (800)-325-8766 or (605)-697-4300 or comparable product from Fair-Play or Spectrum. The scoreboard shall be mounted 10' from finish grade and shall include the following;

1. One (1) "School Name" in place of "HOME"
2. One (1) All Sport® 5010R-6 radio control console
3. One (1) All Sport console carrying case
4. One (1) All Sport battery kit
5. One (1) scoreboard radio control kit
6. One (1) Scoreboard border stripe
7. One (1) Set of White LED Electronic Game Captions
8. Include non-backlit top and bottom sponsor panels 24"h x 18' wide
9. Paint rear, sides and bottom of scoreboard one of standard colors (TBD) to match scoreboard face
10. Individual digit protective screens
11. Scoreboard Uprights painted black
12. Include Horn

13. Power Requirements – 120V; 1445 watt draw -20 amp circuit.

2.2 FOUNDATIONS

A. Foundation design must be stamped by a professional engineer registered in Connecticut and submitted for approval prior to the scoreboard installation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install scoreboards as recommended by the manufacturer and specifications.

B. Construct work plumb, level, and true, with tight, close fitting joints, securely attached and braced to the surrounding construction. Counter bore and predrill for bolt heads, nuts, dowels, and washers, where required, to avoid interference with other materials.

3.2 TESTING AND ADJUSTMENT AND OPERATION

A. Scoreboard systems shall be tested for proper operation and adjusted to conform to specified standards.

B. Provide operating and maintenance instructions to the Owner, including the required manual, in accordance with the Conditions of the Contract.

3.3 CLEANING

A. Upon completion of work in any given area, remove all rubbish and debris from the work area and leave in clean conditions.

END OF SECTION 11 68 43

ISSUED for BID

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. Trash and Recycling Receptacles.
2. Metal Pipe Bollards.

B. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for concrete footings.
2. Section 05 05 13 “Factory-Applied Metal Coatings” for galvanizing/factory-applied primer/factory-applied-paint on metal pipe bollards.
3. Section 31 20 00 "Earth Moving" for excavation for installing concrete footings.
4. Division 1 Section 01 78 30 “Warranties and Bonds” for warranty requirements applicable to the work of this section.

1.3 SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

C. Samples for Initial Selection: For units with factory-applied finishes.

D. Samples for Verification: For each type of exposed finish, not less than 152-mm- (6-inch-) long linear components and 102-mm- (4-inch-) square sheet components.

E. Product Schedule: For site furnishings. Use same designations indicated on Drawings.

F. Connecticut High Performance Building Submittals:

1. Recycled content materials.
2. Local materials.

G. Maintenance Data: For site furnishings to include in maintenance manuals.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Trash Receptacle Inner Containers: two full-size units for each size indicated.
2. Anchors: One dozen for each type and size used.

1.5 WARRANTY

A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of steel or aluminum framed systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.

b. Noise or vibration caused by thermal movements.

c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

d. Water leakage through fixed glazing and framing areas.

e. Failure of operating components to function properly.

2. Warranty Period: As specified in Section 017830 “Warranties and Bonds.”

B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: As specified in Section 017830 “Warranties and Bonds.”

PART 2 - PRODUCTS

2.1 TRASH AND RECYCLING RECEPTACLES

A. Basis of Design Standard: “Lakeside” litter receptacle as manufactured by Landscape Forms, Inc., 431 Lawndale Avenue, Kalamazoo, MI 49048. 800 521-2546 www.landscapeforms.com. Subject to compliance with requirements, provide the named product, or comparable product of Model MLWR650-32 Series as manufactured by Maglin Site Furniture, (800) 716-5506 www.maglin.com or Model Universal Litter & Recycling Receptacle as manufactured by Forms + Surfaces, (800) 451-0410 www.forms-surfaces.com.

1. Style:

a. Side-Opening

b. Capacity- 30 Gallons.

c. Height: 36 ¼ inches

d. Diameter: 21 inches

e. Top: 20” diameter x 1-1/4” tall at top of dome

2. Material:

a. Top: spun 14 gauge spun steel.

b. Liner: Constructed of linear low density polyethylene with 0.100” nominal wall thickness. Color of liner to be selected by Architect.

c. Body: Constructed of 10 gauge HRPO steel welded to a 2” tall toe ring. Side opening litter bodies have (2) 10 ¾” x 5 ¼” openings.

3. Surface Mount: Contractor to provide stainless steel anchor bolts.

4. Finish: Custom laser cut pattern.

   a. Color: Color as selected by Architect from manufacturer's full range including standard colors, premium colors, custom colors, exotic colors and metallic colors.

5. Each receptacle will have manufacturer provided and installed placard indicating “Trash” or “Recycle” at openings.

2.2 METAL PIPE BOLLARDS

A. Fabricate to the dimensions as indicated in the drawings.

1. Metal Pipe Bollard Construction:

   a. Metals, General: Conform to Article 2.2 of Section 05 52 13 Exterior Pipe and Tube Railings.

   b. Steel and Iron: Conform to Article 2.3 of Section 05 52 13 Exterior Pipe and Tube Railings.

   c. Miscellaneous Materials: Conform to Article 2.5 of Section 05 52 13 Exterior Pipe and Tube Railings.

   d. Fabrication: conform to Article 2.6 of Section 05 52 13 Exterior Pipe and Tube Railings.

   e. Finish: conform to Section 05 05 13 Factory-Applied Metal Coatings for hot-Dip galvanizing and Factory-Applied primer and Finish Coat.

2. Style:

   a. Dimensions: As indicated in the Drawings.

   b. Color as selected by Architect from manufacturer's full range including standard colors, premium colors, custom colors, exotic colors and metallic colors."

B. Metal Pipe Bollards shall be installed as indicated on the Drawings.

C. Concrete: State of Connecticut Department of Transportation Standard Specifications for Roads, Bridges, and Incidental Construction Form 817-2016, including current Supplements, Article M.03.01, Class “C”.

2.3 MATERIALS

A. Anchors, Fasteners, Fittings, and Hardware: Stainless steel; commercial quality, tamperproof, vandal and theft resistant, concealed, recessed, and capped or plugged.

1. Angle Anchors: For inconspicuously bolting legs of site furnishings to on-grade substrate; one per leg.

B. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M; recommended in writing by manufacturer, for exterior applications.

C. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound; resistant to erosion from water exposure

without needing protection by a sealer or waterproof coating; recommended in writing by manufacturer, for exterior applications.

2.4 FABRICATION

A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.

B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended, so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.

C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

D. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.

E. Factory Assembly: Factory assemble components to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.5 GENERAL FINISH REQUIREMENTS

A. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

A. Powder-Coat Finish: Manufacturer

B. Manufacturer's standard polyester powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.7 STEEL AND GALVANIZED-STEEL FINISHES

A. Powder-Coat Finish: Manufacturer's standard polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.

D. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site furnishings and 3/4 inch larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

END OF SECTION 12 93 00

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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 requirements for seismic restraints of nonstructural components of the building to remain safe and functional in case of seismic event.

1.3 DEFINITIONS

A. Definitions: Non-structural building components are components or systems that are not part of the building's structural system whether inside or outside, above or below grade. Non-structural components of buildings include:

1. Architectural Elements: Facades that are not part of the structural system and its shear resistant elements; cornices and other architectural projections and parapets that do not function structurally; glazing; nonbearing partitions; suspended ceilings; stairs isolated from the basic structure; cabinets; bookshelves; and storage racks.
2. Electrical Elements: Refer to Division 26 requirements for the following: Power and lighting systems; substations; switchgear and switchboards; auxiliary engine-generator sets; transfer switches; motor control centers; motor generators; selector and controller panels; fire protection and alarm systems; and telephone and communication systems.
3. Mechanical Elements: Refer to requirements in Divisions 21, 22 and 23 for requirements for the following: Heating, ventilating, and air-conditioning systems; medical gas systems; plumbing systems; sprinkler systems; pneumatic systems; boiler equipment and components.

1.4 RELATED WORK:

A. All Sections with requirements for securement of specified components and systems to resist seismic loads, and/or all Sections that directly reference this Section.

1.5 SUBMITTALS:

A. Shop Drawings:

1. Submit a coordinated set of equipment anchorage drawings, prior to installation, including:
    a. All items to be anchored or braced with anchorage or brace points shown.
    b. Details of anchorage or bracing at large scale with all items and connections shown.
    c. Numerical value of design seismic brace loads.
    d. For expansion bolts, include design load and capacity if different from those specified.

B. Design Data: Design calculations prepared and sealed by the registered structural engineer responsible for design of seismic restraints. Show compliance with the more restrictive requirements of Codes and applicable standards.

C. Connecticut High Performance Building Submittals:

1. Recycled Content: Provide data showing postconsumer and preconsumer recycled materials content of materials and fabricated items provided for this project, stated as a percentage of the materials included in these items or materials provided as part of the Work of this Section.

1.6 QUALITY ASSURANCE:

A. Shop-Drawing Preparation: Seismic-force-restraint shop drawings and calculations prepared and sealed by a professional structural engineer experienced in the area of seismic force restraints and registered in the state where the project is located.

B. Coordination:

1. Install seismic restraints only after submittals have been approved by Architect.

2. Coordinate and install multi-pipe hanger systems prior to pipe installation.

1.7 REFERENCES:

A. Publications listed below (including amendments, addenda revisions, supplements and errata) form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only.

B. American Concrete Institute (ACI): ACI 355.2-07 Qualification for Post-Installed Mechanical Anchors in Concrete and Commentary

C. American Institute of Steel Construction (AISC): Load and Resistance Factor Design, Volume 1, Second Edition.

D. American Society for Testing and Materials (ASTM):

1. A36/A36M-05 Standard Specification for Carbon Structural Steel.

2. A53/A53M-07 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

3. A307 (REV A-07 Standard Specification for Carbon Steel Bolts and Studs; 60,000 PSI Tensile Strength.

4. A325-07 Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

5. A325M-05 Standard Specification for High-Strength Bolts for Structural Steel Joints.

6. A490-06 Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength.

7. A490M (REV A-04) Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints.

8. A500/A500M-07 Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

9. A501-07 Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
10. A615/A615M-07 Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
11. A992/A992M (REV A-06) Standard Specification for Steel for Structural Shapes for Use in Building Framing.
12. A996/A996M (REV A-06) Standard Specification for Rail-Steel and Axel-Steel Deformed Bars for Concrete Reinforcement.
13. E488-96(R2003) Standard Test Method for Strength of Anchors in Concrete and Masonry Elements.

E. National Uniform Seismic Installation Guidelines (NUSIG).

F. SMACNA: Seismic Restraint Manual Guidelines for Mechanical Systems

G. FEMA: NEHRP Recommended Seismic Provisions for New Buildings and Other Structures, 2009 Edition.

1.8 REGULATORY REQUIREMENT:

A. 2018 Connecticut State Building Code

B. Exceptions: The seismic restraint of the following items may be omitted:

1. Equipment weighing less than 400 pounds supported directly on floor or roof.
2. Equipment weighing less than 20 pounds suspended from roof or floor.
3. Equipment weighing less than 20 pounds hung from a wall.

PART 2 - PRODUCTS

2.1 STEEL:

A. Structural Steel: ASTM A36.

B. Structural Tubing: ASTM A500, Grade B.

C. Structural Tubing: ASTM A501.

D. Steel Pipe: ASTM A53/A53M, Grade B.

2.2 CAST-IN-PLACE CONCRETE:

A. Concrete: ASTM C150, Type I or II, 28 day strength, f'c = 3,500 psi.

B. Reinforcing Steel: ASTM A615/615M, Grade 60, deformed.

PART 3 - EXECUTION

3.1 CONSTRUCTION, GENERAL:

A. Provide equipment supports and anchoring devices to withstand seismic design forces, so when seismic design forces are applied, equipment cannot displace, overturn, or become inoperable.

B. Provide anchorages in conformance with recommendations of the equipment manufacturer and as shown on approved shop drawings and calculations.

C. Construct seismic restraints and anchorage to allow for thermal expansion.

D. Testing Before Final Inspection:

1. Test 10-percent of anchors in masonry and concrete per ASTM E488, and ACI 355.2 to determine that they meet the required load capacity. If any anchor fails to meet the required load, test the next 20 consecutive anchors, which are required to have zero failure, before resuming the 10-percent testing frequency.

2. Before scheduling Final Inspection, submit a report on this testing indicating the number and location of testing, and what anchor-loads were obtained.

E. Refer to drawings for equipment to be restrained or braced.

3.2 PARTITIONS

A. Independently support and laterally brace all lighting fixtures. Refer to applicable portions of lighting specifications.

3.3 STORAGE RACKS, CABINETS, AND BOOKCASES

A. Install storage racks to withstand earthquake forces and anchored to the floor or laterally braced from the top to the structural elements.

END OF SECTION 13 05 41

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This section includes complete services to provide a permanent prefabricated grandstand seating system with features indicated on the drawings.

B. Complete Scope of Work in this bid package includes the following:

1. AISC certified steel fabrication
2. Galvanized structural steel finish
3. Fully Closed Aluminum Double Lock Welded Deck System
4. Enhanced slip and stain resistant deck finish
5. Powder coated Aluminum Risers
6. Polyboard closure system on front of grandstand and sides of ramp and stairs
7. Prefabricated, modular press box

1.3 REFERENCES

A. CT State Building Code

B. Federal ADA

C. AISC Steel Manual Thirteenth Edition

D. ACI 318-05

E. Aluminum Association Aluminum Design Manual 2010

F. ASTM E985

G. AWS D1.2

1.4 BLEACHER PERFORMANCE REQUIREMENTS

A. Design Loads

Dead Load	6 psf
Live Load	100 psf – limited to L/200
Wind Speed	Design per local wind speeds & building codes
Sway Load	24 plf per row parallel to seatboards
Sway Load	10 plf per row perpendicular to seatboards
Seismic Load	Design per local seismic conditions
Guardrail Loads	50 plf distributed or 200 lb concentrated load applied in any direction

B. Serviceability Requirements

1. Deflection shall be limited to 1/200 of the span for all structural members.

C. Foundation Design

1. Contractor shall provide structural design for bleacher and footings, stamped by a CT registered engineer based on the submitted bleacher product.

2. Foundations shall be designed for bearing, overturning, and sliding for the following load cases as well as all applicable load cases in the building code using an allowable stress design.
   a. 1.0 DL + 1.0 LL + SWAY
   b. 0.6 DL + 1.0 WL
   c. 1.0 DL + 0.75 WL + 0.75 LL

3. Soil bearing capacity has been determined by geotechnical test borings. Foundation sizes if shown on drawings will not be reduced under any circumstances.

D. Bleacher system, ramp, and stairs shall meet or exceed the requirements of local building codes, Americans with Disabilities Act (ADA) and ANSI 117.

1.5 PRESS BOX DESIGN CRITERIA

A. All material and workmanship shall be in accordance with the applicable state building code/ IBC current edition and NFPA.

B. All electric components shall be UL listed.

C. Design Loads:

1. Live Load: 100psf, floor
   50psf, roof
   Wind: Category 2 wind load

D. Design Classification

1. Use Group: A-5, Construction Type: V-B

1.6 SITE REPRESENTATION

A. A qualified representative of the grandstand manufacturer must be onsite at all times during installation of the grandstand.

1.7 QUALITY ASSURANCE

A. AISC Certification: All structural steel shall be fabricated in an American Institute of Steel Construction (AISC) certified plant that is certified "STD" at the time of the bid. The manufacturer shall be listed on AISC's website as a certified fabricator.

B. Experience:

1. Manufacturer of grandstand system shall have a minimum of (5) years' experience in fabrication of grandstand structures and shall, upon request, provide references to successful projects of similar size and project specific requirements.

2. Manufacturer of press box system shall specialize in modular building construction with experience in manufacturing press boxes.

C. Installation: Installation shall be performed by factory trained and certified representatives of the grandstand manufacturer. Installer shall have completed at least three installations of similar size. Documentation shall be provided upon request.

1.8 SUBMITTALS

A. Fabricator AISC Certificate of compliance with the Standard for Steel Building Structures

B. Product Certificate: Prepare written statement on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

C. Shop Drawings: Complete detailed drawings prepared, signed and sealed by a Registered Professional Engineer (P.E.) licensed in the State of Connecticut. Include:

1. Detailed and dimensioned plans.
2. Seating plan indicating aisles, walkways, seating sections and exits and showing exit calculations using appropriate tables and requirements of the Connecticut State Building Code.
3. Sections and details showing complete methods of assembly and anchorage.
4. Footings and foundation sizes and types and relationships to finish grade in compliance with construction documents. Exposed portions of foundations, pier height and top elevations shall be subject to customer approval.
5. Engineering calculations stamped by a Professional Engineer (PE) registered in the State of Connecticut, based upon the submitted manufacturer design.
6. Minimum sizes for structural steel and foundations are shown on bid document drawings, in order to establish an equal bidding opportunity for all participants. Reduction in minimum sizes of concrete foundation and structural steel will not be allowed.

D. NOTE: Delays caused by required resubmittals due to noncompliance with the specification shall not extend any milestone date in the contract. The contractor is responsible for complying with all aspects of this specification.

E. Qualifications of Professional Engineer who seals the shop drawings and calculations.

F. Samples for verification to include 3' section of deck assembly with interlocking riser in specified dimensions and finishes and 3' long seat board with mounting bracket.

1.9 WARRANTY

A. Bleacher system to be guaranteed for five (5) years on the structure and three (3) years on the finishes together with labor.

B. Press box shall be guaranteed for one (1) year against defective material or workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis of design: Dant Clayton Corporation, 1500 Bernheim Lane, Louisville, Kentucky 40210; (800) 626-2177 or equal product from Southern Bleacher Company or E&D Specialty Stands.

2.2 BLEACHER PRODUCT COMPONENTS

A. Fully Closed Welded Deck

1. The decking system has two components. The first component is a one-piece welded deck panel constructed by welding multiple aluminum extensions together in the factory utilizing a fully automated, computer controlled, multi-head welding machine. The welding machine will weld all extrusions together in a single pass with 0.040" diameter 4043 welded wire using Orlion Gas to insure uniform shape, dimension and appearance. The decking system is fixed with a 1% slope to the front to enhance water drainage. The decking system is attached by concealed clips and galvanized hardware. The decking extrusions are 1 ¾" vertically with a .078" wall thickness and are interlocked horizontally prior to welding using a tongue and groove connection.
2. Decking system at front deck and first seating tread shall have perforations or open joints to allow for drainage. Joints and/or perforations shall comply with all local and state building codes and ADA regulations.
3. The second component is a one-piece aluminum riser extension that has a male-female connection at the top with the welded deck panel and a shingled overlap connection at the bottom with the welded deck panel. The riser is finished with a powder coated surface treatment, covering 100% of the riser surface. Riser finish to be Standard Maroon color.
4. The decking system will run from raker beam to raker beam. There will be a ½" gap at joint of the welded deck panels to allow for expansion and contraction of the aluminum due to temperature variations.
5. The joint of the welded deck panel is covered with a 4" wide aluminum extrusion joint cover.
6. Riser height per row and tread depth per row is indicated on design drawings.
7. The ends of decking system will be finished with a one-piece aluminum angle end cap.

B. Seating

1. Seat Brackets shall bolt directly to the steel understructure. Supporting seat brackets in the aluminum channels of the deck will not be permitted.
2. Seats shall be 6063-T6 extruded aluminum with a fluted surface and a minimum of 4 vertical legs. The exact size of seatboard is 2" x 10" x .080" wall thickened at the joints and weighing 1.9 lbs. per foot with 1" radius comfort curve front edge.
3. Mounting brackets: 3/16" thick A36 steel plate, plasma cut, bent and galvanized.

C. Understructure shall consist of an open span I-Beam understructure.

1. Longitudinal bays may include angle cross bracing provided that it does not interfere with building entrances or vomitories.
2. All beams and columns may be made of either wide flange or tube shapes.

3. All steel shall be sized to support the most conservative of the loads in the table above, and the loads in the local building code. If sizes are shown in the drawing, they shall not be reduced for any reason.

D. Railing

1. Vertical guardrail structural supports shall be aluminum rectangular tube 2.8” x 2.0 x .1888" or aluminum angle of equivalent strength, and shall be 6061-T6 alloy. Guardrail shall have structural support on each leg of the fencing at all 90º turns. Tension bars do not meet this requirement.
2. Guardrail horizontal and vertical framing members will be 1 5/8” O.D. aluminum pipe.
3. Chain link fence infill shall be 2” mesh, 6-gauge vinyl coated fabric., Type 2b vinyl fused fabric (ASTM F668).

E. Ramps

1. Ramps shall be configured as shown on drawings.
2. Ramps shall have a maximum slope of 1:12, and shall have the same guard railing as the rest of the grandstand.
3. Ramps shall have a minimum post spacing of 3 ft and a maximum post spacing of 9 ft. Ramps shall be provided with a mid-height grab rail in accordance with ANSI 117.1
4. Material finishes shall match those on the grandstand.

F. Stairs

1. Stairs shall consist of L3x3x1/4" legs with a sloping steel channel supporting the treads. Each tread shall be supported by a clip angle bolted to the sloping channel. Minimum vertical leg spacing is 3 ft. Maximum spacing is 9 ft.
2. Guardrail on the stairs shall match the guardrail on the stand.
3. Material finishes shall match those on the grandstand.

G. Hand & Grab Rails

1. Hand and Grab Rails shall be located in all areas required by building code.
2. Hand and Grab Rails shall be 1-15/16" O.D. extruded aluminum pipe.
3. Two-Line mid-aisle handrails shall be located in all interior aisles. All mid-aisle rails shall feature internal fittings for both lines of rail. External fittings are not permitted. All hand and grab rails shall return to the post or wall per building code and ANSI 117.1.

H. Poly panel vertical closure panels along front of bleacher fully enclosing bleacher components from the walking surface to a maximum 1 ½ “ above adjacent finished grade. Poly panel to be minimum ½” thick, 100% post-consumer re-cycled product that is non-metallic, non-corrosive, wear and abrasion resistant waterproof, impervious to most chemicals and impact resistant with no water absorption properties. Vertical closure material shall be provided in panels and framed on all sides with a heavy-duty aluminum channel integrated with the grandstand and ramping steel and/or aluminum framing. Panels should appear continuous with no exposed frames. Maximum spacing shall be no more than6’-0” on center. Panels shall be provided in color matching powder coated risers. Panel color must be impregnated through the entire panel, painting is unacceptable.

2.3 BLEACHER MATERIALS

A. Structural Steel

1. All detailing, fabrication, and erection shall be completed in accordance with the AISC Steel Construction Manual 13th Edition. All fabrication shall be completed in an AISC certified facility as described in Para. 1.8 A.
2. Structural Steel shall be ASTM A572 multi-certified grade 50. Miscellaneous steel shall be ASTM A36.
3. Bolts & Nuts: All bolts 5/8" diameter and larger shall meet ASTM A325. All bolts 1/2" and small shall meet ASTM A307.
4. All welds shall conform to ANSI/AWS D1.1. Electrodes shall be E70xx.

B. Aluminum

1. All footboards & seatboards shall consist of 6063-T6 aluminum alloy with minimum yield strength of 25 ksi.
2. All straight grab & hand rails shall consist of 6061-T6 aluminum alloy with minimum yield strength of 35 ksi.
3. All bent grab & hand rails shall consist of 6061-T4 aluminum alloy with minimum yield strength of 21 ksi.

2.4 BLEACHER FINISHES

A. Structural Steel

1. All structural steel shall have a factory applied hot dip galvanized finish.
   a. All ferrous metal components shall be blast cleaned to an SSPC-6 commercial blast clean.
2. All structural steel fasteners shall be galvanized.

B. Aluminum

1. All aluminum walking surfaces shall have an enhanced slip and stain resistant finish for safety and aesthetics. This finish shall be produced by the grandstand manufacturer in addition to the mill extrusion process by blasting and then anodizing the aluminum. The blasting process must be performed in a controlled factory environment to ensure consistency. Hand processes or sand blasting is strictly prohibited as they produce an inconsistent finish that is not uniform in appearance or performance.
2. All seat boards shall have a clear anodized finish.
3. All Riser boards shall have a Color Powder Coated finish in one of manufacturer's standard colors to be chosen by owner, covering 100% of the riser surface (Color: Maroon).
4. Powder coat system shall meet or exceed the following test requirements:
   a. Direct Impact Resistance: ASTM D 2794-93, up to 140 in.-lbs.
   b. Flexibility: ASTM D 522-93, Method B, 100% Pass
   c. Pencil Hardness: ASTM D 3363-93a, 3H-4H
   d. Crosshatch Adhesion: ASTM D 3359-97, Method B, 5B, 100% Pass

e. Salt Spray Resistance: ASTM B 117, plus 1,000 hours
f. Humidity Resistance: ASTM D 2247, plus 1,000 hours

5. All hand and Grab Rails shall be clear anodized

C. Covering: 5/8" vinyl-faced gypsum panels, Class A, F.S.R.

D. Insulation: 3-1/2" R-11 fiberglass batts with vapor barrier.

E. Sheathing: 1/2" CDX plywood.

F. Siding: MBCI "U-Panel" .026-gauge ribbed steel panels with Kynar 500 finish color by owner.

2.5 PRESS BOX FLOOR CONSTRUCTION

A. Bottom Board: 1/2" CCX foundation grade treated plywood. Industrial grade asphalt-based pint. Continuous aluminum vents on 8' centers.

B. Insulation: 6" R-19 fiberglass batts, with vapor barrier.

C. Joists: 2" x 6" #2 SYP, on 16" centers, longitudinal framing.

D. Decking: 3/4" Sturdifloor, underlayment grade, tongue and groove fir plywood, (Index 24" O.C.)

E. Covering: 1/8" Armstrong Excelon vinyl composition tile, Cottage Tan

F. Molding: 4" Thermoplastic rubber base molding by Roppe.

2.6 PRESS BOX WALL CONSTRUCTION

A. Studs: 2" x 4", #2 or better SPF, on 16" centers, BOCA framing.

B. Bottom Plate: 2" x 4" #2 or better SPF.

C. Top Plates: (2) 2" x 4" #2 or better SPF.

D. Headers: As span and design load requires

E. Ceiling Height: 8'-2" x 8'-0", front to back.

F. Covering: 5/8" vinyl-faced gypsum panels, Class A, F.S.R.

G. Insulation: R-13 fiberglass batts with vapor barrier.

H. Sheathing: 1/2" CDX plywood.

I. Siding: Metal Sales "U-Panel" .026 Gauge ribbed steel panels w/ Kynar 500 finish.

2.7 PRESS BOX ROOF CONSTRUCTION

A. Joists: 2" x 10", #2 SYP, 16" O.C. spacing.

B. Overhang: 14" over front wall; 6" over rear wall. .019 metal fascia with perforated vinyl soffit panels.

C. Decking: 3/4" tongue & groove oriented strand board (Index 24" O.C.).

D. Insulation: R-38 fiberglass batts with vapor barrier.

E. Ceiling: 5/8" type-x fire-rated gypsum board Class A F.S.R.

F. Ceiling: US Gypsum 24"x24" suspended ceiling system

G. Covering: .060 single-ply EPDM rubber membrane, fully adhered.

2.8 PRESS BOX WINDOWS

A. Soft-Lite "Barrington DSL7 HS", Double horizontal slider windows w/ extruded vinyl frames, AAMA Structural Rating, w/ ¾" insulated Low-E, Argon filled tempered glass w/ removable insect screens.

B. Interior Windows to be ¼" tempered safety glass fixed pan with stained jambs and casing.

2.9 PRESS BOX DOORS

A. 18GA. Insulated hollow metal door with 16 GA. Steel wrap-around frames, 10" x 10" viewing window, vinyl weather-stripping, aluminum threshold and lever handled lock sets.

B. Doors (Interior) - 1-3/8" Solid-core stained birch with stained birch wood jambs and casing and passage lever handled hardware

2.10 PRESS BOX ELECTRICAL COMPONENTS

A. Service Entrance Panel: Square D Q0124M100 with Main Disconnect; rated at 120/240v, single phase, 100 amp capacity.

B. Receptacles: Pass & Seymour 125 volt/15 amp duplex, spec-grade, along the rear wall. Wiremold 5400 Series two-piece multi-channel, dual voltage, non-metallic surface raceway along front wall below scorer's counter, outlets on 48" centers.

C. Lighting: Lithonia M232PC1S 4-ft. 2-tube fluorescent strips with low-glare parabolic diffusers.

D. Circuits: All branch circuit wiring is minimum #12 THHN encased in EMT thin wall conduit or MC Cable.

E. Heat: Berko electric baseboard heaters with integral thermostat.

2.11 PRESS BOX SCORERS' COUNTER

A. 20" deep x 1 ½" Clear Anodized finish aluminum countertop with rounded front nose. Mounted on brackets spaced a minimum of 32".

2.12 PRESS BOX CAMERA DECK

A. Hatch: Bilco Model #NB-50 2'6" x 4'6" aluminum roof hatch with Bil-Gard hatch safety railing.

B. Ladder (Aluminum): Alaco #370 70 degree ships ladder. To comply with detail shown on sheet PB-2

C. Exterior Ladder: JOMY Model #MJO2. Fixed frame retractable exterior access ladder

D. Upgraded Roof Surface: .060 polyester reinforced skid and spike resistant PVC membrane, fully adhered.

E. Railing Mounts: 1/2" galvanized threaded bolts & nuts through roof fascia on 48" centers along perimeter edge of roof. Railing mounts cannot be placed on the roof surface.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine all existing conditions with installer present for compliance with requirements for installation tolerances and other conditions affecting performance of the work.

B. Prepare written report, endorsed by installer, listing conditions detrimental to performance of the work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2. INSTALLATION

A. Installation: Shall be handled directly by the manufacturer or by a factory certified installation subcontractor.

B. Erect per plans, shop drawings, and specifications.

3.3 CLEANING

A. Clean all surfaces according to manufacturer's recommendations.

B. Remove all packaging and construction debris.

C. Use cleaning solutions and methods that do not damage the finishes or the adjacent surfaces.

D. Remove all metal burrs, sharp edges or other cutting, unsafe conditions.

E. Touch up finishes as recommended by manufacturer to the satisfaction of the engineer.

END OF SECTION 13 12 50

ISSUED for BID

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.

B. Refer to section 01 91 00, Commissioning, and 22 08 00, Commissioning of Plumbing Systems, for work related to this section.

1.2 EXAMINATION OF SITE AND DRAWINGS:

A. Before submitting his bid, Contractor shall visit site with plans and specifications in hand, shall consult with the Engineer and shall become thoroughly familiar with all conditions under which his work will be done since he will be held responsible for any assumptions he may make in regard thereto.

B. The Contractor shall verify and obtain all necessary dimensions at the building.

C. Certain present building clearances are available for handling equipment.
All equipment shall be delivered knocked down as necessary to clear restrictions.

1.3 INTENT:

A. Finished Work: The intent of the specifications and drawings is to call for finished work, completed, tested and ready for operation.

B. Good Practice: It is not intended that the drawings show every pipe, fitting or minor detail and it is understood that while the drawings must be followed as closely as circumstances will permit, the systems shall be installed according to the intent and meaning of the Contract Documents and in accordance with good practice.

C. Work under this Section shall include giving written notice to the Agency within 15 days after the Award of the Contract of any materials of apparatus believed inadequate or unsuitable or in violation of any laws or codes, or 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 required items and labor for the satisfactory functioning of the entire system without extra compensation.

D. Any apparatus, appliance, material or work not shown on drawings but mentioned in specifications or vice versa, or any incidental accessories necessary to make the work complete and perfect in all respects and ready for operation, even if not particularly specified, shall be furnished and installed by Contractor at no additional cost to Agency.

E. Prior to receipt of bids, Contractors shall give written notice to Engineer of any materials or apparatus believed inadequate, unsuitable or in violation of laws, ordinances, rules or regulations of authorities having jurisdiction and any necessary items or work omitted.

In the absence of such written notice, it is mutually agreed that Contractor has included the cost of all required items in his proposal and that he will be responsible for approved satisfactory functioning of systems without further compensation.

F. In all cases where apparatus is herein referred to in singular number, it is intended that such reference include as many such items as are required to complete work.

G. If not otherwise specified or shown on plans, apparatus and materials shall be installed in accordance with manufacturer's published recommendations and instructions and to the complete satisfaction of the Architect.

H. It is the intent of these specifications for Plumbing Contractor and/or their subcontractors or equipment suppliers to furnish all equipment complete with all accessories.

1.4 SCOPE OF WORK:

Sanitary, waste and vent systems
Domestic water systems
Plumbing fixtures and equipment

A. This contract includes all labor, material, equipment, tests and appliances required to furnish and install all plumbing as shown on drawings, implied and herein specified.

B. The location of the building will be as shown on drawings. A visit to the site and examination of the Architectural, Structural and other Mechanical trades showing all details of construction is a requirement before submitting a proposal.

C. The drawings are diagrammatic and indicate the general arrangement of piping and equipment, and do not show all minor details and fittings. Such items shall be included, as well as reasonable modifications, in the layout as directed to prevent conflict with other trades.

D. Connect all fixtures, floor drains, and equipment shown on Architectural drawings, as well as on Plumbing drawings. Check all Architectural, Structural and Mechanical drawings and coordinate all the work accordingly.

E. This Contractor shall include in his bid all costs associated with changing all of the room names and numbers at the end of the job from the names and numbers shown on the construction documents to a new set of room names and numbers, inclusive of all re-programming of all MEP and Fire protection systems, etc. Final room numbers will be provided by the Architect to the trade contractors at or around the date of Substantial Completion.

1.5 QUALITY ASSURANCE:

A. Codes and Standards:

1. 2018 Connecticut State Building Code with all the Amendments.
2. 2015 International Building Code
3. 2015 Life Safety Code
4. 2015 International Plumbing Code

5. 2015 International Mechanical Code
6. 2015 NFPA 54.
7. 2015 International Energy Conservation Code
8. Current State of Connecticut Public Health Code
9. 2009 Accessible and Usable Buildings and Facilities - ICC/ANSI A117.1
10. Americans with Disabilities Act – ADA

B. Precedence: Requirements of the above Codes and Regulations that are more restrictive than requirements of the plans and specifications shall take precedence over plans and specifications. Requirements of the plans and specifications that are more restrictive than requirements of the above Codes and Regulations shall take precedence."

C. Equipment construction standards shall be as follows: Pressure vessels shall be constructed in accordance with the ASME Code, all electrical equipment shall be UL listed and approved and conform to the N.E.C., gas equipment shall be approved by A.G.A. and conform to N.F.P.A. Codes, piping materials, fittings, valves and accessories shall be constructed in accordance with A.S.T.M. and A.N.S.I. standards for class of work involved. All equipment and materials shall be new and of domestic manufacture. All the above codes shall be referenced and dated in the Connecticut Basic Building Code.

D. Wherever discrepancies occur between above regulations and agencies and contract drawings and specifications, the requirements of above shall take precedence, except that the contract drawings and specifications shall be minimum requirements and that contractors shall advise engineer of any required changes before proceeding with work.

1.6 PERMITS, FEES:

A. Include all necessary notices, obtain all permits and pay all governmental taxes, fees, and other costs. File all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments having jurisdiction. Obtain all required Certificates of the Agency before request for acceptance and final payment for the work.

1.7 DEFINITIONS:

A. Words "finish" or "finished" refer to all rooms and areas listed in Finish Schedule on Architect's Drawings. All rooms and areas not covered in Schedule, including underground tunnels and areas above ceilings, shall be considered not finished except as otherwise noted.

B. The word "provide" means to "furnish and install" referenced item.

1.8 PROTECTION:

A. Work under each section shall include protecting the work and materials of all other sections from damage by work or workmen, and shall include making good any and all damage thus caused.

B. This section shall be responsible for work and equipment until finally inspected, tested and accepted. Protect work against theft, weather, 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 materials.

C. If so specified under this section, work may include receiving, unloading, uncrating, storing, protecting, setting in place and connecting up completely of any equipment having plumbing service connections which may be furnished by Agency or furnished under another section.

Work under this section shall include exercising special care in handling and protecting equipment and fixtures. Any of the above equipment and fixtures which are missing or damaged by reason of mishandling or failure to protect shall be replaced at no additional cost to the Agency.

1.9 DRAWINGS:

A. The plumbing, mechanical, electrical, structural, and architectural drawings are intended to supplement each other and are to be considered as a unit which, taken together in conjunction with the specifications, completely describes the work to be done. All drawings shall be checked to verify spaces in which work will be installed. Where headroom or space conditions appear inadequate, notification shall be given to Engineer before proceeding with installation.

B. The Engineer may without charge, make modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

C. Note that the drawings are diagrammatic and indicate the general arrangement of the Plumbing equipment and systems, without showing every detail and fitting.

D. Where conflicts occur between drawings and specifications or within either, the item or arrangement of better quality, greater quality or highest cost shall be included in Contract price. Engineer shall determine the manner or item with which work shall be installed.

E. Keep one complete set of all drawings, specifications, shop drawings and addenda on the premises at all times in good condition and available to the Engineer and the Agency.

1.10 REVIEWS:

A. The materials, workmanship, design and arrangement of all work installed under the Plumbing sections shall be subject to the review of the Engineer.

B. Where any specific material process of method of construction or manufactured article is specified by name or by reference to the catalog number of a manufacturer, the specifications are to be used as a guide and not intended to take precedence over the basic duty and performance specified or noted on drawings. In all cases, the specific characteristics of the equipment offered for approval, shall be indicated on the shop drawings.

C. All component parts of each item of equipment or device shall bear the manufacturer's nameplate, giving name of manufacturer, description, size, type, serial or model number, electrical characteristics, etc. in order to facilitate maintenance or replacement. The nameplate of a subcontractor or distributor will not be acceptable.

D. If material or equipment is installed before it is reviewed, it shall be removed and replaced at no extra charge to the Agency if, in the opinion of the Engineer, the material or equipment does not meet the intent of the drawings and specifications.

1.11 SUBMITTALS:

A. Submit under provisions of Section 01 33 00.

B. Contractor shall submit for review shop drawings of all new equipment, materials, piping, and reports in electronic format. Engineer's review of shop drawings must be completed before any equipment is purchased or any work is installed.

C. Shop drawings shall consist of manufacturer's certified scale drawings, cuts or catalog, including descriptive literature and complete certified characteristics of equipment, showing dimensions, capacity, code requirements, motor and drive testing as indicated on the drawings or specifications.

D. Samples, drawings, specifications, catalogs, etc. submitted for review shall be properly labeled indicating specific service for which material or equipment is to be used, division and article number of specifications governing Contractor's name and name of job.

E. Catalog, pamphlets or other documents submitted to describe items on which review is being requested, shall be specific and identification in catalog, pamphlet, etc. of item submitted shall be clearly made in ink. Data of a general nature will not be accepted.

F. Review stamp rendered on shop drawings shall not be considered as a guarantee of measurements of building conditions. Where drawings are reviewed, said review does not mean that drawings have been checked in detail. Said review does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the Contract Drawings and Specifications.

G. Failure by the Contractor to submit shop drawings in ample time for checking shall not entitle him to an extension of Contract and no claim for extension by reason of such default will be allowed.

H. Prior to submission of shop drawings, the Contractor shall thoroughly check each shop drawing, reject those not conforming to the specifications and indicate by his signature that the shop drawings submitted in his opinion meet Contract requirements.

I. Shop Drawings: submit shop drawings, test data and product data for the following:
Plumbing fixtures and trim
Cleanouts
Valves
Floor drains
Pipe, fittings and couplings
Hose Bibbs
Hot water heater
Expansion tank
Thermostatic mixing valve
Water hammer arrestors
Hangers and supports

J. Recycled Content: Provide data showing recycled materials content of materials and fabricated items provided for this project, stated as a percentage of the materials included in these items or materials provided as part of the work of this Section.

K. Before ordering fixtures, Contractor shall submit brochures of all fixtures and trim to the Architect for review.

1.12 PAINTING:

A. Painting is specified elsewhere in the Specifications, under Division 09.

B. Refer to Division 09, for color coded painting of all piping in Mechanical Rooms.

1.13 CONCRETE WORK:

A. Concrete work is specified elsewhere in the specifications under Division 03.

1.14 EXCAVATION AND BACKFILLING:

A. Excavating and backfilling for all plumbing work inside and outside of building shall be done in accordance with Division 31 unless otherwise specified.

1.15 CUTTING AND PATCHING:

A. Cutting and patching shall be done in accordance with Division 01, section 01 73 29 unless otherwise specified.

B. The General Contractor will leave all openings and built-in sleeves, etc. as required, provided he receive same with the proper information and cooperation from the Plumbing Contractor in due time as the construction progresses.
All cutting of openings in walls, floors, partitions, etc. not thus provided for must, however, be done by the Plumbing Contractor as required to install the work including all cutting of existing construction work, and this Contractor shall restore to its original condition any work disturbed.

1.16 WATER FOR CONSTRUCTION PURPOSES:

A. Contractor is referred to Section 01 50 00, Temporary Facilities and Controls, for full description of temporary services.

1.17 PLUMBING SYSTEM DESCRIPTION:

A. Furnish and install all plumbing fixtures shown in the drawings and herein specified. All fixtures shall be complete and perfect and properly connected to the soil, waste, vent and water supply as required and left in complete operation satisfactory to the Architect.

B. All fixture trim shall be furnished in polished brass chrome plated, including supplies, valves, traps, wall flanges and exposed piping.

C. Contractor shall furnish all hangers, chair carriers, bolts and other devices for all fixtures as required to make new fixtures ready for operation in a safe, strong and convenient manner. Fixtures shall be set plumb and true.

D. Contractor shall include all permit fees and connection charges.

PART 2 - PRODUCTS

2.1 MATERIALS AND WORKMANSHIP:

A. All materials and apparatus used shall be new, of first class quality and shall be furnished, delivered, erected, connected and finished in every detail. No materials or apparatus used shall be discontinued or about to be discontinued items.

B. The Engineer shall have the right to reject any part of the work in case material or workmanship is not of satisfactory quality.

C. Any unacceptable work and material shall be replaced with acceptable work and material at no additional expense to the Agency.

D. In case there is any doubt of the acceptability of any material, submit samples to the Engineer for approval and only definite approval in writing from the Engineer shall be evidence of such approval. Such approval shall also be subject to the satisfactory installation of the material.

E. The work in each of these sections shall be constantly under the direction of a competent and thoroughly experienced superintendent who shall be on the premises during such period as the work is in progress. The superintendent shall familiarize himself with the work of all other trades involved insofar as they relate to or in any way affect the work of these sections, and shall coordinate the work.

F. Unless otherwise noted, all equipment and materials shall be installed and/or applied in accordance with the recommendations of the manufacturer of said equipment, including the performance of any tests recommended by the manufacturer.

2.2 EQUIPMENT VARIATIONS:

A. In these specifications and on the accompanying drawings, one or more makes of materials, apparatus or appliances have been specified for use in this installation. This has been done for convenience in fixing the standard of workmanship performance of any materials, apparatus or appliance which shall be substituted for those mentioned herein shall also conform to these standards.

B. Where no specified make or material, apparatus or appliance is mentioned, any first class product made by a reputable manufacturer may be used, providing it conforms to the requirements of these specifications and meets the approval of the Engineer.

C. ***Refer to Section 01 25 00 of the General Requirements of the contract for substitution procedures. Requests for substitutions must be made in writing in prior to bid day. No requests for substitutions will be considered afterwards.***

2.3 PIPE AND FITTINGS:

A. Listed below are references to the specification standards or recognized authorities to which pipe and fitting materials must conform.

B. All reference shall be the current edition as recognized by the active codes. Each pipe length shall have the manufacturer's name cast, stamped or rolled on. Each fitting shall have the manufacturer's symbol and pressure rating cast, stamped or rolled on.

C. Underground Hub and Spigot Cast Iron Soil Pipe and Fittings: To conform to ASTM A 74. Joints shall be made with compression gaskets.

D. Above-ground No-Hub Cast Iron Soil Pipe and Fittings: To conform to CISPI Standard 301. Joints shall be made with neoprene sleeve, stainless steel shield and clamp assembly equal to Tyler wide body 4 clamp arrangement. Other acceptable manufacturers are Mission or MIFAB. Torque clamp screws to the recommended torque by code.

E. Above-ground copper drainage tube type DWV shall conform to ASTM B 306 and fittings to ASME B16.29.

F. Underground Copper Water Pipe and fittings shall conform to ASTM B 88 Standard Specification for Seamless Copper Water Tube, Type K.

G. Above-ground Copper Tubing: To be Type "K" or "L" seamless conforming to ASTM B 88. Cast bronze fittings to conform to ASME B16.18 and wrought copper fittings to conform to ASME B16.22.

H. Solder: To be 95% tin, 5% antimony (lead free) conforming to ASTM B 32, grade 5A.

2.4 HANGERS:

A. Securely hang and anchor pipe as shown and required with proper provision for expansion, contraction and elimination of undue stress and strain on piping.

B. Provide a pipe hanger within two (2) feet of each elbow, tee, wye, valve, strainer and similar device.

C. Secure and support runs at base and at sufficiently close intervals to hold pipe at alignment and to carry safely the weight of piping and contents without undue stress thereon.

D. Except as indicated to the contrary, secure and support all horizontal piping as follows and required to prevent sagging, undue pipe movement and preserve proper alignment in each run.

Piping	Size	Maximum Interval
Cast Iron	All sizes	At each hub or joint
Copper Tubing	1 1/4" & smaller	Five (5) feet
Copper Tubing	1 1/2" & larger	Eight (8) feet

E. Hangers up to and including 2" shall be the adjustable band type equal to Empire. Figure 310 for iron pipe and Fig. 310CT for copper tubing. Other acceptable manufacturers are Tolco or Erico.

F. Hangers for piping 2-1/2" and up shall be the clevis type, equal to Empire. Figure 11 for iron pipe and Figure 110CT for copper tubing. Other acceptable manufacturers are Tolco or Erico.

G. Hangers shall be suspended from one of the following devices:

1. "C" clamps.
2. Trapeze hanger assemblies consisting of back-to-back horizontal steel channels with end-type rod hangers.
3. Expansion shield embedded into concrete or masonry.
4. Anchor hangers to steel structural members, concrete or masonry. Do not anchor to metal floor deck, steel deck tabs or metal roof deck.

2.5 SLEEVES:

A. All outside piping passing through exterior walls, foundation walls and floors shall be furnished with flanged C.I. wall sleeves by Zurn, J.R. Smith, MIFAB or Josam. Furnish with flashing clamp where sleeve passes through waterproof membrane or damproofing.

B. All pipes and conduits passing through floors, walls or partitions shall be provided with sleeves sized to give a minimum of 1/2" clearance between sleeve and the outside diameter of the pipe, conduit or insulation, enclosing the pipe or conduit. Penetrations through fire rated partitions shall be as specified in Section 07 84 13.

C. Sleeves through concrete floors or interior masonry walls shall be Schedule 40 steel pipe, set flush with finished wall or ceiling surfaces, but extending 2 inches above finished floors or shall be in accordance with details on drawings. In all mechanical equipment rooms or penthouses, sleeves shall extend 6 inches above finished floor. Penetrations through fire rated partitions shall be as specified in Section 07 84 13.

D. Inserts shall be individual or strip type of steel or malleable iron construction for removable nuts and threaded rods up to 3/4" diameter, permitting lateral adjustment.

E. Provide escutcheons on all pipes wherever they pass through floors, ceilings, walls, or partitions in finished areas. Escutcheons for pipes passing through floors shall be RITTER PATTERN AND CASTING COMPANY, No. 36A or approved equal in BrassCraft or Watts, split-hinged, cast brass type designated to fit pipe on one end and cover alcove projecting through floor on the other end.
Escutcheons for pipes shall be RITTER PATTERN AND CASTING COMPANY, No. 3A or approved equal in BrassCraft or Watts - split-hinged, cast brass, chromium plated type.

2.6 CLEANOUTS:

A. Cleanouts installed in underground lines shall be extended up to point below finished floor and Contractor shall furnish and install brass frame and flush brass cover located so as to finish flush with finished floor or finished floor covering, whichever applies.

B. Cleanout frames and covers : Jay R Smith Series 4023 for floors and 4422 for walls. Type used to suit finish surface. All exposed tops, flanges and frames shall be of polished brass or stainless steel. Tops in all the mechanical rooms shall be special duty type. Cleanouts of equal quality and design in Zurn, Josam, MIFAB or Wade will be acceptable. In areas where floor covering is provided, furnish cover frame recessed to accept floor covering material such that frame of cover is flush with surrounding finish material.

C. The Contractor shall furnish and install all cleanouts on all sanitary and roof drainage lines at all changes in direction and on straight lines not more than 100'-0" centers, and in any other special locations as may be required by the engineer. Each cleanout shall have a plug and ferrule. Provide access door/cover for all cleanouts installed in concealed sanitary/waste and storm stacks.

2.7 TRAPS:

A. Traps shall be of the same material, finish and size as the pipes on which they occur. All traps shall be provided with suitable openings for cleaning and every trap shall be vented unless otherwise noted, to the full approval of the Plumbing Inspector. The traps used shall in every case meet with approval of the Plumbing Inspector. All traps shall be provided with brass cleanout plug at bottom unless allowed to be omitted in special cases by the Plumbing Inspector.

2.8 FLOOR DRAINS:

A. Refer to the floor drain schedule on Drawings. Floor drains shall be furnished in J.R. Smith, Josam, Zurn, MIFAB or Wade.

B. All floor drains on slab or grade floors shall be furnished with flashing clamp. All floor drains shall be provided with deep seal trap, for min. 4” water seal.

2.9 NON-FREEZE WALL HYDRANTS:

A. Furnish and install in locations shown on drawings Woodford B67 3/4" non-freeze type wall hydrants with bronze casing and finish, loose key shut off and vacuum breaker. Install according to manufacturer's instructions. Other acceptable equals are in T&S Brass, JR Smith or Josam.

B. Contractor shall place wall hydrants in locations where supply pipe will not be in finished rooms. Install hydrant 30 inches above grade. Coordinate with building elevations specified under architectural. Hydrant elevation shall be as specified by the Architect.

2.10 HOSE BIBBS:

A. Furnish and install at locations shown on drawings: Woodford B26 3/4" hose bibbs with polished bronze casing and finish, wheel handle shut off and vacuum breaker. Install according to manufacturer's instructions. Install faucets 24 inches above floor (or as specified on drawings; coordinate with Architectural). Other acceptable equals are in T&S Brass, JR Smith or Josam. Coordinate with interior elevations shown by architectural.

2.11 ACCESS DOORS AND PANELS:

A. Access doors shall be of sufficient size to permit easy replacement of complete units and all groupings of valves and equipment shall have necessary clearance for this same purpose. Doors shall bear the same or greater fire rating as the wall or ceiling in which they occur. Size of doors to be determined after valves are installed and shall be of adequate size to operate same.

B. Furnish and install one flush type access panel or access door for each and every shutoff valve or group of valves located above ceiling or in furred spaces; also for each cleanout located in furred space above ceiling, concealed walls or chases and below floor. Panels shall have metal frames, hinges, and latch. Refer to Section 08 31 16 for additional requirements.

C. All panels occurring in ceilings which are of special finish shall be furnished with 7/8" or 1" depth panel filled in with material to match ceiling. Where panels occur in walls or ceilings which are of plaster, furnish flush panels with metal frame complete.

C. No access panels will be required where "lay-in" ceilings occur, provided suitable plastic markers identifying exact location of valves, cleanouts, etc., on lay-in ceilings are applied directly below valve grouping and identified by a number, this number to be used as a marking on valve chart.

2.12 WATER-HAMMER ARRESTOR:

A. Contractor shall furnish and install water hammer arrestors at ends of headers of all batteries of fixtures and at all individual fixtures on all hot and cold water lines.

The water hammer arrestors shall extend full size of headers.

B. Water hammer arrestors shall be constructed of same type of pipe as used on the system on which it is installed and shall be located so as to be most effective to prevent water hammer or vibration in piping. PPP Water Hammer Arrestors, Wolverine "Tap-Traps" or Nibco Air Chambers may be used.

2.13 INSULATION:

A. Refer to Section 22 07 00.

2.14 VALVES:

A. This Contractor shall furnish and install valves where shown on plans and also wherever necessary to make the system complete in its operation. All valves shall be as manufactured by Stockham, Jamesbury, Appollo, Centerline or Milwaukee as specified.

Hot water and cold water (domestic)

2" and smaller	
Ball valves	Apollo - 71-100/200
Check valves	Stockham B-310-T

2.15 BACKFLOW PREVENTER:

A. 4" Reduced pressure Zone Assembly: Watts Model 957RPDA with non-rising stem gate valves, UL classified and FM approved. Provide with air gap fitting.

B. ¾", 1", & 2" Reduced pressure Zone Assemblies: Watts Model 909 with ball valves. Provide with air gap fitting.

C. Other acceptable manufacturers are Ames or Fabco.

2.16 PLUMBING FIXTURES:

A. Furnish all hangers, carriers, bolts and other devices for all fixtures as required to make new fixtures ready for operation in a safe, strong and convenient manner. Fixtures shall be set plumb and true.

B. Provide all hangers, supports, brackets and carriers for proper installation of the lavatories, sinks, and water closets requiring support. Such supports shall be in accordance with the recommendations of the manufacturers of the fixtures, and if built into partitions or walls, shall be set as the wall progresses. All carrier supports shall be bolted to the floor.
Carriers shall be by Jay R. Smith. Other acceptable manufacturers are Josam, Zurn or Mifab.

C. All fittings, escutcheons, faucets, traps, and exposed piping shall be brass, chrome plated over nickel plate with polished finish. Any hanger visible shall likewise be chrome plated over nickel plate.

D. Provide lavatories with chrome plated stops supply pipes, traps and tail pieces.

E. Refer to drawings for plumbing fixture specifications.

F. Plumbing fixtures are based on Toto. Subject to compliance with requirements provide the named fixtures or comparable fixtures by American Standard, Kohler or Crane.

2.17 THERMAL EXPANSION ABSORBER:

A. Amtrol - Therm-X-Trol Model ST-42V-C ASME thermal expansion tank, with heavy duty butyl diaphragm, rigid polypropylene liner, and brass air charge fitting with protective cap. Other acceptable manufacturers are Bell & Gossett or Taco.

2.18 THERMOSTATIC MIXING VALVE:

A. Symmons 5-200ASB, 3/4" inlets, 3/4" outlet, Tempcontrol Thermostatic water controller with 12 gpm flow at 10 psi pressure drop. ASSE Standard 1017 certified and meeting ASSE Standard 1016 anti-scold requirements. Other acceptable manufacturers are Lawler, Leonard or Bradley.

2.19 PRESSURE REDUCING VALVE:

A. Watts Series 223-S bronze body water pressure reducing valve set at 60 psi and strainer with perforated stainless steel screen. Other acceptable manufacturers are Taco or Zurn.

B. Valve shall meet ASSE Standard 1003 and shall be rated for potable water use.

PART 3 - EXECUTION

3.1 CONNECTING TO EXISTING UTILITIES:

A. Connections to existing utilities that will interrupt the service to the present campus buildings or surrounding neighborhood shall be made at a time agreed upon by the Agency, Architect and Contractor.

B. If it is necessary to make connections to existing utilities outside the regular working hours, this shall be noted on the written work order and the respective Contractor will be paid for the additional cost of labor over and above what it would cost at regular day time rates.

3.2 FREIGHT, CARTING AND RIGGING:

A. Contractor shall pay all freight and carting charges necessary to deliver all equipment furnished under his Contract to the site and furnish all necessary rigging to properly rig and set the apparatus on the pads, foundations, frames, etc.

B. All cranes, lifts, scaffolding, blocks and tackle, ropes and chains and other equipment necessary to rig and set the apparatus shall be furnished by the Contractor.

C. The Contractor shall set, level and align all equipment before starting operations.

3.3 INSTALLATION:

A. This Contractor shall check all architectural, plumbing, fire protection, HVAC and electrical drawings as well as the structural drawings to make sure that his piping will not conflict with such work.

B. All piping work shall be installed with provisions to allow for expansion and contraction of lines so as to prevent any undue strains on pipe and fittings, any trapping of lines or lifting or dislocating of any appliances. Rectify without cost to the Agency any conditions of noisy circulation due to trapped or air bound lines, including the expense of cutting and repairing of the building structure incident to making such alterations.

C. Install the work to conform to space conditions and the work of other trades. The drawings indicate generally the runs and the sizes of piping and although the size must not be decreased, nor the drawings deviated from except as unforeseen space conditions may require, the Engineer reserves the right to make minor changes in the arrangement of the work to meet the conditions arising during construction.

3.4 COOPERATION WITH OTHER TRADES:

A. No piping shall be installed until the entire run has been checked for clearance and the work has been coordinated between all the trades. This Contractor shall be responsible for taking his own field measurements and maintaining proper clearance from the Agency's equipment and the work of other trades, and for coordinating his work with that of other Contractors and Agency. Furnish all necessary information, dimensions, templates, etc. in order that a perfectly coordinated job will result.

B. This Contractor shall carry out his work in conjunction with other trades and shall give full cooperation to other trades. This Contractor shall furnish all information necessary to permit work of all trades to be installed in a satisfactory manner.

C. Where space is so limited that Contractor's work shall be installed in close proximity to the work of other trades or where it is evident that Contractor's work will interfere with other trades, he shall assist in working out space conditions to make satisfactory adjustments. If required or directed by Engineer, the Contractor shall prepare composite working drawings, in addition to the coordination drawings, and sections of not less than 3/4" -1'-0" scale clearly showing how his work is to be installed in conjunction with other trades; he shall make corrections necessary to satisfactorily complete installation at no additional cost to the Agency.

D. All supports for hanging material to be connected to steel structure shall be installed prior to installation of fire proofing materials. Refer to Division 7 of the specifications.
Any damage to fireproofing caused by late installation of hanging material shall be repaired by the Fire-proofing Contractor at the expense of the Contractor responsible.

E. This Contractors shall give to the Electrical Contractor all information on switches, controls, pilots, etc. furnished under the Plumbing Contract, together with makes and catalog numbers where required to permit the Electrical Contractor to leave the proper boxes to receive same. This information shall be given well in advance so that the Electrical Contractor may install his work as construction progresses. In the event that this information is not given in time to permit the Electrical Contractor to leave proper boxes, etc. as construction progresses, it shall be the responsibility of the Contractor to pay all costs of cutting and patching construction required because of this neglect.

3.5 TESTS:

A. Furnish all labor and materials for the performance of all tests on water piping, sewers, waste piping, vent piping as may be required by the authorized inspectors having jurisdiction or as may be required by the Architect or his authorized representative.

3.6 GRADES:

A. Pipes shall be laid to a uniform grade not less than 1/8" to the foot unless otherwise indicated on plans. Consult with the Contractor under other Sections concerning the pipes to be laid in trenches. All vertical lines shall be set plumb and true. All changes in direction shall be made with Y-1/8 or 1/16 bends with cleanouts at every change in direction greater than 45 deg.

3.7 UNDERGROUND WASTE AND VENT PIPING:

A. All work below floors and in fill inside building shall be cast iron bell and spigot, unless otherwise noted. All underground pipe shall be pitched at least 1/8" per foot. Openings through outside walls shall be provided for all lines running through walls at proper elevation. Drainage piping shall be sized as shown by Drawings but not less than 3 inches diameter. Vent piping shall be sized as shown by Drawings but not less than 2 inches diameter.

3.8 ABOVEGROUND WASTE AND VENT PIPING:

A. All soil, waste and vent, unless otherwise specified herein or shown on plans, shall be no-hub cast iron. DWV or Type "L" copper tubing and drainage fittings shall be allowed for branch and 2” and smaller piping.

B. Traps of all plumbing fixtures shall be vented to prevent loss of trap seal.

C. All vents shall be sized as shown by Drawings but not less than 1 ½ inches. All vent terminals through the roof shall be sized not less than 4 inches.

D. All soil, waste and vent pipes to be concealed in finished areas.

E. All soil, waste and vent piping shall be subject to the full approval of the local Plumbing Inspector.

F. In special cases, because of appearance or limited space conditions, install wastes in copper-nickel alloy steel screwed pipe, or copper tubing of weight required by local codes.

G. All vent pipes shall be properly connected to the vertical vent stacks and extended through the roof. Vent lines from various stacks may be connected together in the space between ceiling and roof so that the number of vents passing through roof may be kept at a minimum.

The location of all vents passing through the roof shall be approved by the Architect before being installed.

3.9 COLD WATER PIPING:

A. All water piping shall be run concealed in ceilings and in pipe spaces in ceilings and in finished area.

B. At low points, provide valved drain with hose connection. Arrange piping to pitch to low points or fixtures so that entire system may be drained.

C. Provide ball valves on all branches off main and sectional valves on main. Provide stops at each individual fixture. All valves shall be tagged.

D. All cold water piping shall be Type "L" hard tempered copper tubing with wrought copper sweat fittings or pro-press fittings

E. All exposed un-insulated water piping to individual fixtures in finished rooms shall be chrome plated.

3.10 HOT WATER PIPING:

A. Extend the hot water piping as shown on plans which, in general, will follow the cold water. All piping in finished rooms shall be run concealed throughout. Extend piping to fixtures and equipment as shown on the plans, providing ball valve shutoffs in all branches and drains with hose cocks at all low points.

B. All hot water piping shall be Type "L" hard tempered copper tubing with wrought copper sweat fittings or pro-press fittings.

C. All exposed piping to individual fixtures, in finished rooms, shall be chrome plated.

3.11 PIPING JOINTS:

A. Soldered Joints in Copper Tube: Cut the ends of tubes square, remove burrs, clean tube ends and fitting sockets with emery cloth, and remove all particles before applying flux and making the joint. Insert tubes to full socket depth. Use the following solders at the given conditions.

B. All solder joints shall be made up with 95/5 solder.

C. Plumbing Contractor shall be held responsible for any damages caused by water from poorly made joint.

3.12 CAST IRON JOINTS:

A. All joints on buried cast iron shall be with compression type gaskets.

B. All joints on above ground cast iron shall be with no-hub couplings.

3.13 REAMING OF PIPES:

A. All pipes to be carefully reamed after cutting and threading.

B. All pipes on brass, iron or steel pipe lines shall be reamed carefully before they are threaded. They shall be reamed smooth on the inside to give the full area of pipe in all cases.

C. All copper tubing shall be carefully cut square and true, carefully reamed and thoroughly cleaned. The inside of fittings shall be carefully cleaned. On tubing 1-1/2" and larger, the end of tubing shall be thoroughly tinned. All tubing shall be inserted fully to the shoulder of fittings.

3.14 FIRE STOPPING:

A. General

1. Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies. See division 07 84 13 for additional requirements.

B. General Description of the Work : Only tested firestop systems shall be used in specific locations as follows: Penetrations for the passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.

C. References

1. Test Requirements: ASTM E-814, "Standard Method of Fire Tests of Through Penetration Fire Stops" (July 1997).

2. Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E-814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually.
3. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments
4. Test Requirements: ASTM E 84-96, "Surface burning characteristics".

5. All major building codes: ICBO, SBCCI, BOCA, and IBC.

6. Test Requirements: ASTM E-119, “Fire Test of Building Construction and Materials” (UL 263)

D. Quality Assurance

1. Firestop System installation must meet requirements of ASTM E-119, ASTM E-814, ASTM E-84-96, UL 236, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated.

2. Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.

E. Submittals

1. Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions to comply with Section 01 33 00.

2. Submit material safety data sheets provided with product delivered to job-site.

F. Installer Qualifications

1. Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacture’s products per specified requirements.

G. Products, General

1. 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 the firestopping manufacturer based on testing and field experience.
2. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

3. Firestopping Materials are either “cast-in-place” (integral with concrete placement) or “post installed.” Provide cast-in-place firestop devices prior to concrete placement.

H. Acceptable Manufacturers

1. Subject to compliance with through penetration firestop systems (XHEZ) and joint systems (XHBN) listed in Volume II of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:

   a. Hilti, Inc., Tulsa, Oklahoma 800-879-8000
   b. Nelson Firestop Products.
   c. Specified Technologies Inc.
   d. 3M Fire Protection Products Division.

I. Materials

1. Use only firestop products that have been UL 1479, ASTM E-814, or UL 2079 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

2. Provide a firestop system with a "F" Rating as determined by UL 1479 or ASTM E814 which is equal to the time rating of construction being penetrated.

3. Provide a firestop system with an Assembly Rating as determined by UL 2079 which is equal to the time rating of construction being penetrated.

J. Preparation

1. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

   a. Verify penetrations are properly sized and in suitable condition for application of materials.

b. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may effect proper adhesion.
c. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
d. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
e. Do not proceed until unsatisfactory conditions have been corrected.

K Coordination

1. Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.

2. Responsible trade to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

L. Installation

1. Regulatory Requirements: Install firestop materials in accordance with UL Fire Resistance Directory.

2. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration and construction joint materials.

a. Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
b. Consult with project manager, and damper manufacturer prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
c. Protect materials from damage on surfaces subjected to traffic.

M. Field Quality Control

1. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
2. Keep areas of work accessible until inspection by applicable code authorities.
3. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

N. Adjusting and Cleaning

1. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
2. Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

3.15 ACCESSIBILITY:

A. Locate all equipment which must be serviced, operated or maintained in fully accessible positions. If required for better accessibility, furnish access doors for this purpose. Access doors shall be selected by the Architect/Engineer to specific area finishes. Minor deviations from drawings may be made to allow for better accessibility, only if approved by the Engineer. Provide fire rated access doors in rated walls, access doors shall be provided in accordance with Section 08 31 16.

B. In the event that any equipment is not installed to permit convenient servicing, disassemble, removal of parts, etc. the Contractor shall, at his own expense, make all corrections necessary to accomplish this.

3.16 TAGS, CHARTS AND NAMEPLATES:

A. Each valve and any piece of apparatus installed under these sections shall be properly identified.

B. Each sectional shutoff valve shall have a brass tag with identifying number. Tag shall be secured to valve stem with sufficient length of copper coated jack chain to allow tag to be easily read.

C. All other equipment shall be proved with a suitable laminated plastic nameplate fastened with screws or rivets. Small equipment labels may use a pressure sensitive tape.

D. All nameplates and labels shall identify components by proper nomenclature and numbered according to equipment schedule or as designated.

E. Charts shall be furnished in duplicate and shall include the valve identification number, location and purpose. One chart shall be mounted in frame with a clear glass front and secured to wall in location directed. Second chart shall be for use throughout building and shall be provided with transparent plastic closure for top and attached 8" bead chain for hanging. Holes to be reinforced with brass grommets. Tags and closures as manufactured by Seton Name Plate Corp., New Haven, Conn., or approved equal in Brady or Kolbi.

3.17 INSTRUCTIONS:

A. Prepare written instructions frames for the proper maintenance and operation of any special equipment furnished and installed under this Contract.

B. Personally instruct the Agency's Maintenance Staff or official representative in addition to furnishing all manuals, diagrams, etc. in the proper operation and maintenance of all equipment and piping installed under this Contract.

C. Prepare a portfolio with all tags, operating manuals, parts lists, guarantees, etc. that are packed with all equipment furnished under this Contract and submit same to the Architect.

3.18 PIPING CODE MARKERS:

A. All service piping which is accessible for maintenance operations, except piping in finished spaces, shall be identified with vinyl plastic color bands and legends at each branch and riser take-off, at

each passage through wall, floor and ceiling, adjacent to each valve and on all pipe runs marked each 20'-0"on center.

Vinyl plastic bands shall not be used in plenum ceilings. Use self-Adhesive aluminum pipe markers or pipe stencils in plenum areas.

B. Pipe markers to conform to A.S.A. Bulletin A-13. Where pipes are too small for legends, brass identification tags 1-1/2" in diameter with depressed 1/2" high black filled letters shall be fastened with chain. Pipe markers and tags as manufactured by the Seton Name Plate Corp., New Haven, Conn., or equal approved in Brady or Kolbi.

3.19 EQUIPMENT NOT IN CONTACT AND FURNISHED UNDER OTHER SECTIONS:

A. Furnish all piping and make all closing connections to equipment furnished by other Trade Contractors and Agency; include installation of all special traps, control valves and supplies furnished with such equipment. Refer to section in which outlines equipment requirements and all other specifications sections as may be pertinent to comply with intent of this Article.

B. Unless otherwise detailed on drawings, roughing of proper size and capacity for equipment indicated on Architectural Mechanical or Electrical drawings as "Future" or "NIC" shall be provided and installed in such a manner and location that future final connection can be made with a minimum of work and without cutting or patching walls, partitions, ceilings or floors.

C. Engineers' drawings are, of necessity, schematic for special equipment as exact roughing and requirements may vary with different manufacturers. Contractor is also referred to Architectural drawings and details.

D. Contractor shall obtain approved shop drawings of equipment being furnished for extent of final connections and exact roughing required.

3.20 TOILET ROOM ACCESSORIES:

B. Toilet room accessories are furnished and installed under another section of the specifications.

3.21 EQUIPMENT PREPURCHASED BY AGENCY:

A. The Agency has purchased plumbing equipment listed elsewhere. This Contractor shall be given the purchase order and shall, at that time, assume full responsibility for delivery, installation and guarantee of said equipment as if he has purchased the equipment.

3.22 CLEANING PIPING, CONDUITS AND EQUIPMENT:

A. Thoroughly clean all piping and equipment of all foreign substances inside and out before being placed in operation.

B. If any part of a system should be stopped or otherwise impacted by any foreign matter after being placed in operation, the system shall be disconnected, cleaned and reconnected wherever 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 Agency.

C. During the course of construction, all pipes shall be capped in an approved manner to insure adequate protection against the entrance of foreign matter, moisture, etc.

3.23 CLEANING UP:

A. After completion of the work, remove all waste, rubbish and other materials left as a result of operations and leave the premises in clean condition.

B. All fixtures, equipment, etc. installed under the Plumbing Sections shall be free of dirt, grease and other foreign material and left in perfectly clean condition and ready to use.

3.24 WARRANTY:

A. All parts of the work and all equipment shall be guaranteed for a minimum period of 18 months from the date of substantial completion. Please see section 01 78 30 for warranty requirements specific to the equipment or system.

B. If during that warranty period, any part of the work installed fails, becomes unsatisfactory or does not function properly due to any fault in material or workmanship, whether or not manufactured or job built, each section shall upon notice from the Agency, promptly proceed to repair or replace such faulty material or workmanship without expense to the Agency, including cutting, patching and painting or any other collateral work involved and including repair or restoration of any damaged sections of the premises resulting from such faults.

C. In the event, that a repetition of any one defect occurs, indicating the probability of further failure, and which can be traced to faulty product design, materials or workmanship, then repairs or replacement shall not continue to be made but, the fault shall be remedied by a complete replacement of the entire defective unit.

D. In addition to the general warranty, obtain and transmit to the Agency any guarantees or warranties from manufacturers of specialties but only as a supplement to the general warranty which will not be invalidated by same.

3.25 AGENCY'S INSTRUCTIONS AND SYSTEM OPERATION:

A. Contractor shall submit Instructions on CD-ROM of on-site video. Refer to Section 01 77 00, paragraph 1.5.G for additional requirements.

B. Upon completion of all work and of all tests, Contractor shall furnish the necessary skilled labor and helpers for operating the system and equipment for a period of four (4) days of eight (8) hours. During this period, instruct the Agency or its representative fully in operation, adjustment and maintenance of all equipment furnished. Give at least forty-eight (48) hours notice to the Agency in advance of this period.

3.26 AGENCY'S ACCEPTANCE TEST:

A. After the various systems are complete as determined by preliminary operating tests, the Contractor shall arrange for the Agency's final acceptance tests.

B. The Contractor shall have present at each acceptance test, representatives of the several Contractors whose work is directly or indirectly involved, with instruments as necessary to validate proper performance in accordance with the design and to include the following:

1. All equipment installed and operating in accordance with manufacturer's instructions and performance guarantee.
2. All systems operating in accordance with specifications.
3. All distribution systems properly adjusted for distribution to equipment as specified.
4. The various systems properly flushed, cleaned, and free of entrapped air and dirt.
5. All `as built` drawings, valve charts, etc. as specified in various parts of the specifications installed and/or ready for delivery to the Agency.

C. THE DATE OF THE ISSUANCE OF A FORMAL CERTIFICATE OF SUBSTANTIAL COMPLETION SHALL BE THE START OF THE WARRANTY PERIOD. ALL WARRANTY PERIODS APPILCABLE TO THE WORK UDER THIS PROJECT ARE AS SPECIFIED BY SECTION 01 78 30 “WARRANTIES AND BONDS”.

3.27 TEST:

A. All piping testing to be performed in accordance with all applicable Codes including, but not limited to IPC.

B. All involved parties are to be notified at least two weeks in advance of a scheduled test.

C. Conducting Tests: Conduct all tests as required and repair or replace any defects. Perform all tests in the presence of and to the satisfaction of the Engineer and such other parties as may have legal jurisdiction.

D. Defective Work: The Agency shall have the privilege of stopping any of the work not being properly installed. All such defective work shall be repaired or replaced and the tests shall be repeated.

D. Repair Damaged Work: Repair all damages resulting from tests and replace damaged materials.

3.28 DISINFECTION:

A. Disinfect new water piping in accordance with AWWA C651.

1. The pipe system shall be flushed with clean, potable water until dirty water does not appear at the points of outlet.

2. The system or part thereof shall be filled with a water/chlorine solution containing at least 50 parts per million (50mg/L) of chlorine, and the system or part thereof shall be valved off and allowed to stand for 24 hours; or the system or part thereof shall be filled with water/chlorine solution containing at least 200 parts per million (200mg/L) of chlorine and allowed to stand for 3 hours.

3. Following the required standing time, the system shall be flushed with clean potable water until the chlorine is purged from the system.

4. The procedure shall be repeated where shown by a bacteriological examination that contamination remains present in the system.

5. Contractor shall submit chlorination test results for review and acceptance by the Code official.

END OF SECTION 22 05 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including General and Supplementary Conditions and Division 01, General requirements, apply to the work specified in this Section.

B. The requirements in Section 22 05 00 shall also govern the work under this Section.

C. Scope of Work: This Section contains details for the insulation of pipe and equipment installed under Division 22.

1.2 SUBMITTALS:

A. In accordance with Section 01 33 00, the following items shall be submitted for approval.

Piping insulation
Fitting insulation

B. Recycled Content: Provide data showing recycled materials content of materials and fabricated items provided for this project, stated as a percentage of the materials included in these items or materials provided as part of the Work of this Section.

C. Connecticut High Performance Building Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that product complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.3 MECHANICAL SYSTEMS INSULATION:

A. Furnish and install all thermal and protective insulation as specified herein for piping and equipment as shown on the drawings.

B. The following mechanical items shall be insulated:
Piping – hot and cold water
Fittings - Valve bodies, Victaulic couplings, elbows, tees, etc.

1.4 SYSTEM PERFORMANCE

A. Insulation materials furnished and installed hereunder should meet the minimum thickness requirements of ASHRAE 90.1 (2015), "Energy Efficient Design of New Buildings," of the American Society of Heating, Refrigeration, and Air Conditioning Engineers. However, if other factors such as condensation control or personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor.

B. Insulation materials furnished and installed hereunder shall comply with NFPA 255 and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with the following testing standard:

Underwriters' Laboratories, Inc. UL 723

Adhesives used for applying the sealed jackets shall also conform to these same ratings. The use of wheat paste or any other material not meeting these requirements will not be allowed.

1.5 QUALITY ASSURANCE

A. Insulation materials and accessories furnished and installed hereunder shall, where required, be accompanied by manufacturers' current submittal or data sheets showing compliance with applicable specifications.

B. Insulation materials and accessories shall be installed in a workmanlike manner by skilled and experienced workers who are regularly engaged in commercial insulation work.

C. All covering and insulating materials shall be manufactured by Johns Manville, Knauf, Owens-Corning or Armstrong.

1.6 DELIVERY AND STORAGE OF MATERIALS

A. All of the insulation materials and accessories covered by this specification shall be delivered to the job site and stored in a safe, dry place with appropriate labels and/or other product identification.

B. The contractor shall use whatever means are necessary to protect the insulation materials and accessories (wick material, sealing tape, etc) before, during, and after installation. No insulation material shall be installed that has become damaged in any way. The contractor shall also use all means necessary to protect work and materials installed by other trades.

PART 2 – PRODUCTS

2.1 PIPING:

A. Insulate all new domestic hot and cold water lines with Johns Manville Fiberglass ASJ with S.S.L. II, pipe insulation with double self-sealing lap having a factory applied jacket. All horizontal and vertical insulated piping located below 8'-0" AFF level and not protected with enclosures shall be protected with Zeston 2000 P.V.C. 30 Mil jacketing. Outdoor, exposed piping shall be protected with aluminum jacket.

B. All concealed piping shall be covered as follows: Apply insulation to clean dry pipe with side and end joints butted tightly. Seal lap of jacket and butt joint strips with Benjamin Foster 82-07 vapor barrier lap adhesive. Insulate fittings, flanges and valves of piping with mitered pipe insulation, or F/G premolded fittings made smooth with insulating cement and jacket with glass cloth saturated with Benjamin Foster 30-60 lagging adhesive. Vinyl or plastic fitting jackets will be allowed.

C. Insulate domestic cold water, water cooler waste, (70 degrees F. and below) in the same as for hot piping above except vapor seal all joints, seams, elbows and fittings.

D. For all insulated pipes exposed to weather apply a 16 mil embossed aluminum jacket with 2" overlap at longitudinal and circumferential joints. Secure in place with 3/4" x .015" aluminum band 18" on centers. All seams shall be sealed weather tight.

E. Foam insulation:

1. Piping and Fittings. MicroLok plain pipe insulation shall be wired or taped in place over clean, dry pipe with all joints butted firmly together. Vapor retarder shall be Micro-Lok AP-T plus.

2. The insulation shall be finished with metal jacketing with a laminated moisture retarder. Metal jacketing shall be overlapped 2 to 3 inches (51 to 76 mm) and held in place with sheet metal screws or metal bands.

3. Elbows and tees shall be finished with matching metal fitting covers. Other fittings in metal-jacketed systems shall be finished with conventional weather-resistant insulating materials with painted aluminum finish.

F. Provide minimum insulation thickness in accordance with the following table.
Minimum Pipe Insulation

Piping System Types	Fluid Temp. Range	Runouts 2 in +	1 in. and less	1-1/4 to 2 in.	2-1/2 to 4 in.	5 and Larger
	F	in.	in.	in.	in.	in.
Plumbing Systems						
Hot Water	100-200	1.0	1.5	1.5	2	2
Cold Water Cond. Drains	Below 70	0.5	1.5	1.5	1.5	1.5

Reinsulate piping/duct where insulation has been disturbed under this contract and feather to remaining insulation.

2.2 HANDICAP SINKS:

A. Provide Trubro Lav Guard 2 insulation kits on drain tailpiece, traps, angle valves and water pipes below handicap Lavatories and Sinks. When protected from access, drain, water pipes and angle valves below handicap fixtures do not need the insulation kits.

2.3 FITTING COVERS:

A. Fitting covers may be used in lieu of insulating cement and jacket. Provide fitting covers in Zeston - 2000 P.V.C. (20 Mil thickness) by Johns Manville.

B. General - The matching insert (fiberglass) should either be wrapped completely around the fitting or snugly positioned inside the fitting for proper fit. The insert shall cover the full inner surface area of the fitting cover. The fitting cover is then to be applied over the fitting and insert, and the throat secured by either tack fastening, taping, or banding.

C. Cold Pipe - Fitting systems below ambient temperature must have a continuous vapor barrier, either with pressure sensitive PVC Tape, or an approved adhesive system. When PVC Tape is used, a 2" downward lap is required. On cold lines in severe ambient temperatures, the fiberglass insert shall be the same thickness as the adjacent pipe insulation. All joints shall then be sealed with PVC Tape.

D. Hot Pipe - For hot piping which requires pipe insulation over 1-1/2" wall, an extra inch of wall thickness in the pipe insulation shall be applied. If the surface temperature of insulation exceeds 155 degrees F. fitting covers should not be used. The throat seam shall be riveted or tacked on hot piping.

PART 3 – EXECUTION

3.1 SITE INSPECTION

A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.

B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturer’s recommendations.

C. Verify, by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments, that all materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and physical properties.

3.2 PREPARATION

A. Ensure that insulation is clean, dry, and in good mechanical condition and that all factory-applied facings are intact and undamaged. Wet, dirty, or damaged insulation is not acceptable for installation.

B. Ensure that pressure testing of piping, duct and fittings has been completed prior to installing insulation.

3.3 INSTALLATION

A. General

1. Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.
2. Install insulation on piping/duct subsequent to painting, and acceptance tests.

3. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.

B. Fittings

1. Wrap valves, fittings, and similar items in each piping system with wicking material to ensure a continuous path (100% coverage) for the removal of condensation.
2. Cover valves, fittings, and similar items in each piping system using one of the following:

   a. Mitered sections of insulation equivalent in thickness and composition to that installed on straight pipe runs.
   b. PVC Fitting Covers insulated with material equal in thickness and composition to adjoining insulation.

3. Seal all fitting joints with contractor supplied VaporWick Sealing Tape or approved vapor retarder mastic compound.

C. Penetrations

Extend piping without interruption through walls, floors and similar piping penetrations.

3.4 SEAMS:

A. On exposed insulation, all longitudinal seams shall be kept at the top and back of the pipe and circumferential joints shall be kept to a minimum. Raw end of insulation shall be concealed by neatly folding the ends of the jackets. Fittings, valve bodies and flanges shall be furnished with the same jacket materials used on adjoining insulation.

3.5 PRIOR TESTING:

A. Covering shall not be applied until all parts of the work have been tested by the Contractor and reviewed by the Engineer.

3.6 VAPOR BARRIER:

A. Vapor barrier shall be applied in accordance with the manufacturer's instructions to maintain the integrity of the vapor barrier on cold systems.

B. An approved vapor retarder mastic compatible with PVC must be applied between pipe insulation and fitting cover, and on fitting cover and throat overlap seam.

B. For fittings where operating temperature is below 45 deg. For where pipe insulation thickness is greater than 1 ½", two or more layers of Hi-Lo temp insulation inserts shall be installed beneath fitting cover.

3.7 METAL SHIELDS:

A. Metal shields, 16 gauge galvanized, shall be applied between hangers or supports and the pipe insulation. Shields shall be roll formed to fit the insulation and shall extend up to the center line of the pipe and the length specified for the insert. Insulation shall be rigid type for length of shield to prevent crushing.

3.8 FIELD QUALITY ASSURANCE

A. Upon completion of all insulation work covered by this specification, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

B. Replace any ceiling damage caused by condensation due to improper covering and sealing during the guarantee period of this job.

3.9 PROTECTION

A. Replace damaged, removed or disturbed insulation with appropriate fiberglass insulation.

B. The insulation contractor shall advise the general and/or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

3.10 SAFETY PRECAUTIONS

A. Insulation contractor's employees shall be properly protected during installation of all insulation. Protection shall include proper attire when handling and applying insulation materials, and shall include (but not be limited to) disposable dust respirators, gloves, hard hats, and eye protection.

B. The insulation contractor shall conduct all job site operations in compliance with applicable provisions of the Occupational Safety and Health Act, as well as with all state and/or local safety and health codes and regulations that may apply to the work.

END OF SECTION 22 07 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General provisions of the Contract, including General and Supplementary Conditions, General Requirements apply to the work specified in this Section.

B. Scope of Work: This Section contains special provisions for Divisions 23.

C. Section 01 78 30 "Warranties and Bonds" for warranty requirements applicable to the work of Mechanical Sections.

D. This project will be commissioned. Refer to sections 01 91 00, 01 91 13, 23 08 00, for commissioning information and responsibilities. The commissioning process will require additional labor, material and/o other costs which must be provided by the work of this Division.

1.2 EXAMINATION OF SITE AND DRAWINGS:

A. Before submitting his bid, Contractor shall visit site with plans and specifications in hand, shall consult with the Engineer and shall become thoroughly familiar with all conditions under which his work will be done since he will be held responsible for any assumptions he may make in regard thereto.

B. The Contractor shall verify and obtain all necessary dimensions at the building.

C. Certain present building clearances are available for handling equipment.
All equipment shall be delivered knocked down as necessary to clear restrictions.

1.3 INTENT:

A. Finished Work: The intent of the specifications and drawings is to call for finished work, completed, tested and ready for operation.

B. Good Practice: It is not intended that the drawings show every pipe, fitting or minor detail and it is understood that while the drawings must be followed as closely as circumstances will permit, the systems shall be installed according to the intent and meaning of the Contract Documents and in accordance with good practice.

C. Work under this Section shall include giving written notice to the Agency within 15 days after the Award of the Contract of any materials of apparatus believed inadequate or unsuitable or in violation of any laws or codes, or 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 required items and labor for the satisfactory functioning of the entire system without extra compensation.

D. Any apparatus, appliance, material or work not shown on drawings but mentioned in specifications or vice versa, or any incidental accessories necessary to make the work complete and perfect in all

respects and ready for operation, even if not particularly specified, shall be furnished and installed by Contractor at no additional cost to the Agency.

E. Prior to receipt of bids, Contractors shall give written notice to Engineer of any materials or apparatus believed inadequate, unsuitable or in violation of laws, ordinances, rules or regulations of authorities having jurisdiction and any necessary items or work omitted.
In the absence of such written notice, it is mutually agreed that Contractor has included the cost of all required items in his proposal and that he will be responsible for approved satisfactory functioning of systems without further compensation.

F. In all cases where apparatus is herein referred to in singular number, it is intended that such reference include as many such items as are required to complete work.

G. If not otherwise specified or shown on plans, apparatus and materials shall be installed in accordance with manufacturer's published recommendations and instructions and to the complete satisfaction of the Architect.

H. It is the intent of these specifications for Mechanical and Electrical Contractors and/or their subcontractors or equipment suppliers to furnish all equipment complete with all accessories.

1.4 REGULATIONS:

A. Codes: All work shall be done in strict accordance with the 2018 Connecticut State Building, 2018 Connecticut State Fire Safety Code, 2015 IBC, 2015 IPC, 2015 IMC, Connecticut Public Health Code, 2015 NFPA 101, all applicable NFPA Codes, NEC, UL, NEMA, O.S.H.A., with all requirements of local utility companies and the requirements of all governmental departments having jurisdiction.

B. Precedence: Requirements of the above Codes and Regulations that are more restrictive than requirements of the plans and specifications shall take precedence over plans and specifications. Requirements of the plans and specifications that are more restrictive than requirements of the above Codes and Regulations shall take precedence.

C. Equipment construction standards shall be as follows: Pressure vessels shall be constructed in accordance with the ASME Code, all electrical equipment shall be UL listed and approved and conform to the N.E.C., gas equipment shall be approved by A.G.A. and conform to N.F.P.A. Codes, piping materials, fittings, valves and accessories shall be constructed in accordance with A.S.T.M. and A.N.S.I. standards for class of work involved. All equipment and materials shall be new and of domestic manufacture. All the above codes shall be referenced and dated in the Connecticut Basic Building Code.

D. Wherever discrepancies occur between above regulations and agencies and contract drawings and specifications, the requirements of above shall take precedence, except that the contract drawings and specifications shall be minimum requirements and that contractors shall advise engineer of any required changes before proceeding with work.

1.5 APPROVED FITTINGS:

A. No material other than that contained in the "Latest List of Electric Fittings" approved by the Underwriters' Laboratories, Inc., shall be used in any part of the work. All wiring, conduit, switches and other material for which label service has been established, shall bear the label of the Underwriters' Laboratories, Inc.

1.6 PERMITS, FEES:

A. Include all necessary notices, obtain all permits and pay all governmental taxes, fees, and other costs. File all necessary plans, prepare all documents and obtain all necessary approvals of all governmental departments having jurisdiction. Obtain all required Certificates of the Agency before request for acceptance and final payment for the work.

1.7 DEFINITIONS:

A. Words "finish" or "finished" refer to all rooms and areas listed in Finish Schedule on Architect's Drawings. All rooms and areas not covered in Schedule, including underground tunnels and areas above ceilings, shall be considered not finished except as otherwise noted.

B. The word "provide" means to "furnish and install" referenced item.

1.8 PROTECTION:

A. Work under this section shall include protecting the work and materials of all other sections from damage by work or workmen, and shall include making good any and all damage thus caused.

B. This section shall be responsible for work and equipment until finally inspected, tested and accepted. Protect work against theft, weather, 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 materials.

C. If so specified under the respective section, work may include receiving, unloading, uncrating, storing, protecting, setting in place and connecting up completely of any motor starters, control equipment having mechanical/electrical service connections which may be furnished by Agency or furnished under another section.

Work under this section shall include exercising special care in handling and protecting equipment and fixtures. Any of the above equipment and fixtures which are missing or damaged by reason of mishandling or failure to protect shall be replaced at no additional cost to the Agency.

1.9 EQUIPMENT SUBSTITUTIONS AND DEVIATIONS:

A. Wherever more than one manufacturer is mentioned in specifications and drawings, any of these named are considered equally acceptable to that on upon which design was based and, providing all requirements are met, insofar as performance, space requirements, noise levels and special accessories or materials are concerned, any of those named may be included in Contractor's bid. Please refer to section 01 25 00 for additional requirements specific to substitutions.

B. Where Contractor proposes to use an item of equipment which differs from that upon which design was based, which required any redesign of structure, partitions, foundations, piping, wiring or of any other part of Mechanical, Electrical or Architectural Layout, all such redesign, new drawings or detailing required shall be prepared by Contractor at his own expense for approval of Engineer.

C. Where approved substitutions or deviations require a different quantity, size or arrangement of structural supports, wiring, conduit, piping, ductwork, and equipment from that upon which design was based, all additional items required by the systems shall, with the approval of Engineer, be furnished by Contractor at no additional cost to Agency.

D. Requests for substitutions must be made in writing prior to bid day. No requests for substitutions will be considered afterwards.

1.10 DRAWINGS:

A. The, mechanical, fire protection, plumbing, electrical, structural, and architectural drawings are intended to supplement each other and are to be considered as a unit which, taken together in conjunction with the specifications, completely describes the work to be done. All drawings shall be checked to verify spaces in which work will be installed. Where headroom or space conditions appear inadequate, notification shall be given to Engineer before proceeding with installation.

B. The Engineer may without charge, make modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

C. Note that the drawings are diagrammatic and indicate the general arrangement of the Mechanical and Electrical Equipment and systems, without showing every detail and fitting.

D. Where conflicts occur between drawings and specifications or within either, the item or arrangement of better quality, greater quality or highest cost shall be included in Contract price. Engineer shall determine the manner or item with which work shall be installed.

E. Keep one complete set of all drawings, specifications, shop drawings and addenda on the premises at all times in good condition and available to the Engineer and Agency.

1.11 REVIEWS:

A. The materials, workmanship, design and arrangement of all work installed under the Mechanical section shall be subject to the review of the Engineer.

B. Where any specific material process of method of construction or manufactured article is specified by name or by reference to the catalog number of a manufacturer, the specifications are to be used as a guide and not intended to take precedence over the basic duty and performance specified or noted on drawings. In all cases, the specific characteristics of the equipment offered for approval, shall be indicated on the shop drawings.

C. All component parts of each item of equipment or device shall bear the manufacturer's nameplate, giving name of manufacturer, description, size, type, serial or model number, electrical characteristics, etc. in order to facilitate maintenance or replacement. The nameplate of a subcontractor or distributor will not be acceptable.

D. If material or equipment is installed before it is reviewed, it shall be removed and replaced at no extra charge to the Agency if, in the opinion of the Engineer, the material or equipment does not meet the intent of the drawings and specifications.

1.12 SHOP DRAWINGS:

A. Contractor shall submit for review shop drawings of all new equipment, materials, piping and reports in electronic format. Engineer's review of shop drawings must be completed before any equipment is purchased or any work is installed. Please refer to section 01 33 00 for additional submittal requirements.

B. Shop drawings shall consist of manufacturer's certified scale drawings, cuts or catalog, including descriptive literature and complete certified characteristics of equipment, showing dimensions, capacity, code requirements, motor and drive testing as indicated on the drawings or specifications. Also, sheet metal fabrication drawings drawn to scale of 1/4" to the foot or larger.

C. Certified performance curves for all pumping equipment shall be submitted for review.

D. Samples, drawings, specifications, catalogs, etc. submitted for review shall be properly labeled indicating specific service for which material or equipment is to be used, division and article number of specifications governing Contractor's name and name of job.

E. Catalog, pamphlets or other documents submitted to describe items on which review is being requested, shall be specific and identification in catalog, pamphlet, etc. of item submitted shall be clearly made in ink. Data of a general nature will not be accepted.

F. Review stamp rendered on shop drawings shall not be considered as a guarantee of measurements of building conditions. Where drawings are reviewed, said review does not mean that drawings have been checked in detail. Said review does not in any way relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by the Contract Drawings and Specifications.

G. Failure by the Contractor to submit shop drawings in ample time for checking shall not entitle him to an extension of Contract and no claim for extension by reason of such default will be allowed.

H. Prior to submission of shop drawings, the Contractor shall thoroughly check each shop drawing, reject those not conforming to the specifications and indicate by his signature that the shop drawings submitted in his opinion meet Contract requirements.

1.13 QUIET OPERATION:

A. Mechanical equipment shall operate without objectionable noise or vibration as determined by the Architect/Engineer. Noise level in any normally occupied area shall not exceed that of an NC-28 curve (noise criteria-28) as established in the latest edition of the ASHRAE Guide.

B. Mechanical Contractor shall carry an allowance for performing sound pressure measurements in areas designated by the Agency and/or Engineer as unacceptable. Each test shall be performed on a time and material bases. Tests shall be performed after regular working hours.

C. The Contractor shall demonstrate compliance with the design noise criteria, by measuring the sound pressure levels in octave-bands from 125Hz to 8000 Hz. Measurements shall be taken 5ft. above the floor, at four locations as directed by the Engineer. Sound pressure shall be determined as an average of these octave band readings. Contractor shall use Type 1 sound level meters with octave-band filters. Contractor shall demonstrate that the instruments used in the measuring process have been calibrated by a recognized testing facility within one year. In processing the test results, the Contractor shall follow the recommendation of ARI Standard 885-90.

D. If objectionable noise or vibration are produced and transmitted to occupied portions of the building by apparatus, piping, or other parts of the mechanical and electrical work, changes or additions, as are necessary, shall be made to the system, as approved, without extra cost to the Agency.

1.14 PAINTING:

A. Painting is specified elsewhere in the Specifications, under Division 09.

B. Refer to Division 09, for color coded painting of all piping in Mechanical Rooms.

1.15 CONCRETE WORK:

A. Concrete work is specified elsewhere in the specifications under Division 03.

1.16 EXCAVATION AND BACKFILLING:

A. Excavating and backfilling for all mechanical and electrical work inside and outside of building shall be done in accordance with Division 31 unless otherwise specified.

1.17 CUTTING AND PATCHING:

A. Cutting and patching shall be done in accordance with Division 01, section 01 73 29 unless otherwise specified.

B. The General Contractor will leave all openings and built-in sleeves, etc. as required, provided he receive same with the proper information and cooperation from the Electrical and/or Mechanical Contractor in due time as the construction progresses.
All cutting of openings in walls, floors, partitions, etc. not thus provided for must, however, be done by the Electrical and/or Mechanical Contractor as required to install the work including all cutting of existing construction work, and this Contractor shall restore to its original condition any work disturbed.

1.18 TEMPORARY HEAT:

A. Contractor is referred to Section 01 50 00, Temporary Facilities and Controls for full description of temporary services.

B. New air distribution systems ***shall not*** be used for temporary heating, cooling or ventilation.

C. Contractor shall provide extended warranties for all equipment used for temporary services.

PART 2 - PRODUCTS

2.1 MATERIALS AND WORKMANSHIP:

A. All materials and apparatus used shall be new, of first class quality and shall be furnished, delivered, erected, connected and finished in every detail. No materials or apparatus used shall be discontinued or about to be discontinued items.

B. The Engineer shall have the right to reject any part of the work in case material or workmanship is not of satisfactory quality.

C. Any unacceptable work and material shall be replaced with acceptable work and material at no additional expense to the Agency.

D. In case there is any doubt of the acceptability of any material, submit samples to the Engineer for approval and only definite approval in writing from the Engineer shall be evidence of such approval. Such approval shall also be subject to the satisfactory installation of the material.

E. The work in each of these sections shall be constantly under the direction of a competent and thoroughly experienced superintendent who shall be on the premises during such period as the work is in progress. The superintendent shall familiarize himself with the work of all other trades involved insofar as they relate to or in any way affect the work of these sections, and shall coordinate the work.

F. Unless otherwise noted, all equipment and materials shall be installed and/or applied in accordance with the recommendations of the manufacturer of said equipment, including the performance of any tests recommended by the manufacturer.

2.2 EQUIPMENT VARIATIONS:

A. In these specifications and on the accompanying drawings, one or more makes of materials, apparatus or appliances have been specified for use in this installation. This has been done for convenience in fixing the standard of workmanship performance of any materials, apparatus or appliance which shall be substituted for those mentioned herein shall also conform to these standards.

B. Where no specified make or material, apparatus or appliance is mentioned, any first class product made by a reputable manufacturer may be used, providing it conforms to the requirements of these specifications and meets the approval of the Engineer.

C. ***Refer to Section 01 25 00 of the General Requirements of the contract for substitution procedures. Requests for substitutions must be made in writing in prior to bid day. No requests for substitutions will be considered afterwards.***

D. To substitute other makes of materials, apparatus or appliance, than those mentioned under the mechanical or electrical sections, a request in writing to be allowed to make the substitution shall

be made. This request shall be accompanied by complete plans and specifications of the substitution offered. If so requested by the Architect or Engineer, also submit samples of both the specified material or appliance and the substitute.

2.3 ELECTRIC MOTORS:

A. All motors 1/2 h.p. and above shall be integral horsepower polyphase induction motors conforming to NEMA standards MG-1-1967 and shall be T-frame design in sizes 143 T through 445 T. Each shall be NEMA design B with minimum torque valves per MG 1-12.37 and 12.38. Duty shall be continuous, ambient temperature 40 degrees maximum, allowable temperature rise for open drip-proof -90 degrees, TEFC, 80 degrees C with Class B insulation rating all per MG 1-12.42.

B. Horsepower, speed and frame sized per MG 1-10, 32, 13.02 and 13.06a.

C. Enclosures - open drip-proof and TEFC per MG 1-1.25, 1.26 and 1.27.

D. All dimensions per MG 1-11.31a, 11.32a and 11.34a. All motors shall have stainless steel nameplates with NEMA voltage standards shown.

E. Locked rotor KVA per horsepower shall be designated by proper NEMA code letter per MG 1.10.37.

F. All motors shall be premium efficiency type with a full load efficiency range of 80 percent to 95 percent. High efficiency motor rating shall meet Northeast Utilities Energy Action Program in accordance with the following schedule:

MINIMUM NOMINAL MOTOR EFFICIENCIES

HP	OPEN DRIP PROOF			HP	TOTALLY ENCLOSED		
	MINIMUM EFFICIENCY				MINIMUM EFFICIENCY		
	1200	1800	3600		1200	1800	3600
1	82.5%	85.5%	80.0%	1	82.5%	85.5%	78.5%
1.5	86.5%	86.5%	85.5%	1.5	87.5%	86.5%	85.5%
2	87.5%	86.5%	86.5%	2	88.5%	86.5%	86.5%
3	89.5%	89.5%	86.5%	3	89.5%	89.5%	88.5%
5	89.5%	89.5%	89.5%	5	89.5%	89.5%	89.5%
7.5	91.7%	91.0%	89.5%	7.5	91.7%	91.7%	91.0%
10	91.7%	91.7%	90.2%	10	91.7%	91.7%	91.7%
15	92.4%	93.0%	91.0%	15	92.4%	92.4%	91.7%
20	92.4%	93.0%	92.4%	20	92.4%	93.0%	92.4%
25	93.0%	93.6%	93.0%	25	93.0%	93.6%	93.0%
30	93.6%	94.1%	93.0%	30	93.6%	93.6%	93.0%
40	94.1%	94.1%	93.6%	40	94.1%	94.1%	93.6%
50	94.1%	94.5%	93.6%	50	94.1%	94.5%	94.1%
60	95.0%	95.0%	94.1%	60	94.5%	95.0%	94.1%
75	95.0%	95.0%	94.5%	75	95.0%	95.4%	94.5%
100	95.0%	95.4%	94.5%	100	95.4%	95.4%	95.0%

G. Service Factors - open-drip-proof, 1 h.p. through 200-1.15 TEFC all horsepower - 1.0.

H. Noise level within NEMA standard MG 1-12.49.

I. In addition to the above, all motors 1 through 20 h.p. shall be TEFC with drain holes for both horizontal and vertical positions. Each shall be equipped with deep groove double shielded ball bearings prelubricated with provisions for regreasing.

J. Motors smaller than 1/2 h.p. shall be capacitor-start or split-phase type designed for 120 volts, single phase, 60 cycles alternating current.

2.4 ELECTRICAL MOTOR STARTERS:

A. Motor starters and variable frequency drives (VFD'S) shall be furnished by this Contractor for motor driven equipment provided under this section. The Electrical Contractor shall install the starters and VFD'S, and shall provide all power wiring to the starters and VFD'S, and from the starters and VFD'S to the motors they control.

B. Motor starters and VFD'S shall conform to requirements of NEC, NEMA, UL, CSA, and ANSI and shall be suitable for the required horsepower, duty, voltage, phase, frequency, service, and location. All starters and VFD'S shall be furnished in NEMA enclosures suitable for the environment in which they are to be located.

C. All starters shall be of the same manufacture and shall be furnished in Cutler-Hammer, General Electric, Square D, or Allen Bradley.

D. Thermal Overloads:

1. All motors 1/8 horsepower or larger shall be provided with thermal-overload protection. Thermal overloads shall be melting alloy ambient temperature compensating type.
2. Thermal overloads shall be sized in accordance with NEC requirements for the nameplate data of the motor(s) as actually delivered to the site.

E. Starters for manual control of single phase motors up to one (1) horsepower furnished without integral thermal overloads shall be combination manual disconnect switch and starters with thermal overload protection for each ungrounded leg. Starters shall be inoperable if a thermal unit is removed. These starters shall be 2-pole and shall be provided with green neon pilot light and handle guard/lock-off.

F. Starters for three phase motors shall be full voltage, circuit breaker combination magnetic starters. All circuit breaker combination magnetic starters shall include melting alloy type thermal overload protection, low voltage protection, and two (2) sets of auxiliary normally open and normally closed contacts. Thermal overload protection shall be provided in each ungrounded leg. Starters shall be inoperable if a thermal unit is removed. All circuit breaker combination magnetic starters shall be equipped with control power circuits. Provide starters with control power transformers of secondary voltage required for the control power circuitry. Provide control power transformers with primary and secondary fusing. The disconnect handle on circuit breaker combination magnetic starters shall always be in control of the disconnect device with the door opened or closed. The

disconnect handle shall be clearly marked as to whether the disconnect device is "on" or "off", and shall include a two- color handle grip, the black side visible in the "off" position, and the red side visible in the "on" position.

1. All circuit breaker combination magnetic starters for manual control of three phase motors shall have start-stop push buttons in the cover and shall be provided with red and green pilot lights.
2. All circuit breaker combination magnetic starters for automatic or interlocking control of three phase motors shall have hand-off-automatic selector switches in the cover and shall be provided with red and green pilot lights.

2.5 ACCESS DOORS:

A. Access doors shall be of sufficient size to permit easy replacement of complete units and all groupings of complete units and all groupings of valves and equipment shall have necessary clearance for this same purpose. Provide access doors for each valve, damper, control, fire damper, etc., not accessible (such as above a non-lift out ceiling, wall or chase). See Division 08 31 16 for detailed requirements for access doors and frames. Doors shall bear the same or greater fire rating as the wall or ceiling in which they occur. Size of doors to be determined after valves or dampers are installed and shall be of adequate size to operate same.

B. Where access is required to dampers, valves, etc., that occur above lay-in ceilings, these access doors may be omitted, provided suitable plastic markers identifying exact location of valves, dampers, etc., on lay-in ceilings are applied directly below valve grouping and identified by a number, this number to be used as a marking on valve or damper chart. Tags shall be applied on the ceiling grid, not on the ceiling tiles. Tag samples shall be submitted to the Architect and Engineer for approval prior to fabrication and installation of said tags.

PART 3 - EXECUTION

3.1 CONNECTING TO EXISTING UTILITIES:

A. Connections to existing utilities that will interrupt the service to the present campus buildings or surrounding neighborhood shall be made at a time agreed upon by the Agency, Architect and Contractor.

B. If it is necessary to make connections to existing utilities outside the regular working hours, this shall be noted on the written work order and the respective Contractor will be paid for the additional cost of labor over and above what it would cost at regular day time rates.

3.2 FREIGHT, CARTING AND RIGGING:

A. Contractor shall pay all freight and carting charges necessary to deliver all equipment furnished under his Contract to the site and furnish all necessary rigging to properly rig and set the apparatus on the pads, foundations, frames, etc.

B. All cranes, lifts, scaffolding, blocks and tackle, ropes and chains and other equipment necessary to rig and set the apparatus shall be furnished by the Contractor.

C. The Contractor shall set, level and align all equipment before starting operations.

3.3 COOPERATION WITH OTHER TRADES:

A. No piping, ducts, valves, boxes, etc., shall be installed until the entire run has been checked for clearance and the work has been coordinated between all the trades. This Contractor shall be responsible for taking his own field measurements and maintaining proper clearance from the Agency's equipment and the work of other trades, and for coordinating his work with that of other Contractors and Agency. Furnish all necessary information, dimensions, templates, etc. in order that a perfectly coordinated job will result.

B. This Contractor shall carry out his work in conjunction with other trades and shall give full cooperation to other trades. Contractor shall furnish all information necessary to permit work of all trades to be installed in a satisfactory manner.

C. Where space is so limited that Contractor's work shall be installed in close proximity to the work of other trades or where it is evident that Contractor's work will interfere with other trades, he shall assist in working out space conditions to make satisfactory adjustments. If required or directed by Engineer, the Contractor shall prepare composite working drawings, in addition to the coordination drawings, and sections of not less than 3/4" -1'-0" scale clearly showing how his work is to be installed in conjunction with other trades; he shall make corrections necessary to satisfactorily complete installation at no additional cost to Agency.

D. All supports for hanging material to be connected to steel structure shall be installed prior to installation of fire proofing materials. Refer to Division 7 of the specifications.
Any damage to fireproofing caused by late installation of hanging material shall be repaired by the Fire-proofing Contractor at the expense of the Contractor responsible.

E. The Plumbing and Heating Contractors shall give to the Electrical Contractor all information on switches, controls, pilots, etc. furnished under the Plumbing and Heating Contracts, together with makes and catalog numbers where required to permit the Electrical Contractor to leave the proper boxes to receive same. This information shall be given well in advance so that the Electrical Contractor may install his work as construction progresses. In the event that this information is not given in time to permit the Electrical Contractor to leave proper boxes, etc. as construction progresses, it shall be the responsibility of the Contractor to pay all costs of cutting and patching construction required because of this neglect.

3.4 INFORMATION FOR ELECTRICAL CONTRACTOR:

A. Deliver to the Electrical Contractor all information on motors and controls furnished under the Mechanical Contract, together with makes and catalog numbers, to permit the Electrical Contractor to leave the proper boxes and wiring.

B. Each electric motor of 1/2 h.p. or more shall be furnished with an automatic starter.

C. Starters shall be furnished in type to be remotely controlled and fed from dual voltage transformer 208/460 120 volts.

D. Starters to have overload and undervoltage protection. Starters shall be of the combination disconnect switch and starter type.

3.5 SLEEVES, INSERTS AND ANCHOR BOLTS:

A. This section shall provide and shall be held responsible for the location and position of all sleeves, inserts, and anchor bolts required by the work. Failure to do so, which requires cutting and patching of finished work, shall be done at no additional cost to Contract.

B. All pipes passing through floors, walls or partitions shall be provided with sleeves sized to give a minimum of 1/2" clearance between sleeve and the outside diameter of the pipe, conduit or insulation, enclosing the pipe or conduit.

C. Sleeves through concrete floors or interior masonry walls shall be Schedule 40 steel pipe, set flush with finished wall or ceiling surfaces, but extending 2 inches above finished floors or shall be in accordance with details on drawings.

In all mechanical equipment rooms or penthouses, sleeves shall extend 6 inches above finished floor.

D. Inserts shall be individual or strip type of steel or malleable iron construction for removable nuts and threaded rods up to 3/4" diameter, permitting lateral adjustment.

E. Provide escutcheons on all pipes and conduits wherever they pass through floors, ceilings, walls, or partitions in finished areas. Escutcheons for pipes passing through floors shall be RITTER PATTERN AND CASTING COMPANY, No. 36A or approved equal in BrassCraft or Watts, split-hinged, cast brass type designated to fit pipe on one end and cover alcove projecting through floor on the other end.
Escutcheons for pipes shall be RITTER PATTERN AND CASTING COMPANY, No. 3A or approved equal in BrassCraft or Watts - split-hinged, cast brass, chromium plated type.

3.6 FIRE STOPPING:

A. General

1. Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies. See division 07 84 13 for additional requirements.

B. General Description of the Work : Only tested firestop systems shall be used in specific locations as follows: Penetrations for the passage of duct, cable, cable tray, conduit, piping, electrical busways and raceways through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.

C. References

1. Test Requirements: ASTM E-814, "Standard Method of Fire Tests of Through Penetration Fire Stops" (July 1997).

2. Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E-814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually.

3. International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments

4. Test Requirements: ASTM E 84-96, "Surface burning characteristics".

5. All major building codes: ICBO, SBCCI, BOCA, and IBC.

6. Test Requirements: ASTM E-119, “Fire Test of Building Construction and Materials” (UL 263)

D. Quality Assurance

1. Firestop System installation must meet requirements of ASTM E-119, ASTM E-814, ASTM E-84-96, UL 236, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of construction being penetrated.

2. Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.

E. Submittals

1. Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions to comply with Section 01 33 00.

2. Submit material safety data sheets provided with product delivered to job-site.

F. Installer Qualifications

1. Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacture’s products per specified requirements.

G. Products, General

1. 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 the firestopping manufacturer based on testing and field experience.

2. Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

3. Firestopping Materials are either “cast-in-place” (integral with concrete placement) or “post installed.” Provide cast-in-place firestop devices prior to concrete placement.

H. Acceptable Manufacturers

1. Subject to compliance with through penetration firestop systems (XHEZ) and joint systems (XHBN) listed in Volume II of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:

   a. Hilti, Inc., Tulsa, Oklahoma 800-879-8000
   b. Nelson Firestop Products.
   c. Specified Technologies Inc.
   d. 3M Fire Protection Products Division.

I. Materials

1. Use only firestop products that have been UL 1479, ASTM E-814, or UL 2079 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

2. Provide a firestop system with a "F" Rating as determined by UL 1479 or ASTM E814 which is equal to the time rating of construction being penetrated.

3. Provide a firestop system with an Assembly Rating as determined by UL 2079 which is equal to the time rating of construction being penetrated.

J. Preparation

1. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

   a. Verify penetrations are properly sized and in suitable condition for application of materials.
   b. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may effect proper adhesion.
   c. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
   d. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
   e. Do not proceed until unsatisfactory conditions have been corrected.

K Coordination

1. Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.

2. Responsible trade to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

L. Installation

1. Regulatory Requirements: Install firestop materials in accordance with UL Fire Resistance Directory.

2. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration and construction joint materials.

   a. Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
   b. Consult with project manager, and damper manufacturer prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
   c. Protect materials from damage on surfaces subjected to traffic.

M. Field Quality Control

1. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
2. Keep areas of work accessible until inspection by applicable code authorities.
3. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

N. Adjusting and Cleaning

1. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
2. Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

3.7 ACCESSIBILITY:

A. Locate all equipment which must be serviced, operated or maintained in fully accessible positions. Equipment shall include but not be limited to motors, controllers, switchgear, drain points, etc. If required for better accessibility, furnish access doors for this purpose. Access doors shall be selected by the Architect/Engineer to specific area finishes. Minor deviations from drawings may be made to allow for better accessibility, only if approved by the Engineer. Provide fire rated access doors in rated walls, access doors shall be provided in accordance with Section 08 31 16.

B. In the event that any equipment is not installed to permit convenient servicing, disassemble, removal of parts, etc. the Contractor shall, at his own expense, make all corrections necessary to accomplish this.

3.8 LUBRICATION:

A. All equipment having moving parts and requiring lubrication which is installed under this Contract, shall be properly lubricated according to manufacturer's recommendations prior to testing and operation.
Any such equipment discovered to have been operated before lubrication is subject to rejection and replacement at no cost to the Agency. Units furnished with sealed bearings are accepted.

3.9 TAGS, CHARTS AND NAMEPLATES:

A. Each valve, control, switch, electrical panel, motor and any piece of apparatus installed under this section shall be properly identified.

B. Each sectional shutoff valve shall have a brass tag with identifying number. Tag shall be secured to valve stem with sufficient length of copper coated jack chain to allow tag to be easily read.

C. All other equipment, including panels and switches, shall be proved with a suitable laminated plastic nameplate fastened with screws or rivets. Small equipment labels may use a pressure sensitive tape.

D. All nameplates and labels shall identify components by proper nomenclature and numbered according to equipment schedule or as designated.

E. Charts shall be furnished in duplicate and shall include the valve identification number, location and purpose. One chart shall be mounted in frame with a clear glass front and secured to wall in location directed. Second chart shall be for use throughout building and shall be provided with transparent plastic closure for top and attached 8" bead chain for hanging. Holes to be reinforced with brass grommets. Tags and closures as manufactured by Seton Name Plate Corp., New Haven, Conn., or approved equal in Brady or Kolbi.

3.10 INSTRUCTIONS:

A. Prepare written instructions frames for the proper maintenance and operation of any special equipment furnished and installed under this Contract.

B. Personally instruct the Agency's Maintenance Staff or official representative in addition to furnishing all manuals, diagrams, etc. in the proper operation and maintenance of all equipment and piping installed under this Contract.

C. Prepare a portfolio with all tags, operating manuals, parts lists, guarantees, etc. that are packed with all equipment furnished under this Contract and submit same to the Architect.

3.11 PIPING CODE MARKERS:

A. All service piping which is accessible for maintenance operations, except piping in finished spaces, shall be identified with vinyl plastic color bands and legends at each branch and riser take-off, at each passage through wall, floor and ceiling, adjacent to each valve and on all pipe runs marked each 20'-0"on center.

Vinyl plastic bands shall not be used in plenum ceilings. Use self-Adhesive aluminum pipe markers or pipe stencils in plenum areas.

B. Pipe markers to conform to A.S.A. Bulletin A-13. Where pipes are too small for legends, brass identification tags 1-1/2" in diameter with depressed 1/2" high black filled letters shall be fastened with chain. Pipe markers and tags as manufactured by the Seton Name Plate Corp., New Haven, Conn., or equal approved in Brady or Kolbi.

3.12 EQUIPMENT NOT IN CONTACT AND FURNISHED UNDER OTHER SECTIONS:

A. Furnish all piping sheet metal connections and miscellaneous accessories, and make all closing connections to equipment furnished by other Trade Contractors and Agency; include installation of all special traps, control valves and supplies furnished with such equipment. Refer to section in which outlines equipment requirements and all other specifications sections as may be pertinent to comply with intent of this Article.

B. Unless otherwise detailed on drawings, roughing of proper size and capacity for equipment indicated on Architectural drawings as "Future" or "NIC" shall be provided and installed in such a manner and location that future final connection can be made with a minimum of work and without cutting or patching walls, partitions, ceilings or floors.

C. Engineers' drawings are, of necessity, schematic for special equipment as exact roughing and requirements may vary with different manufacturers. Contractor is also referred to Architectural drawings and details.

D. Contractor shall obtain approved shop drawings of equipment being furnished for extent of final connections and exact roughing required.

3.13 CLEANING PIPING, CONDUITS AND EQUIPMENT:

A. Thoroughly clean all piping and equipment of all foreign substances inside and out before being placed in operation.

B. If any part of a system should be stopped or otherwise impacted by any foreign matter after being placed in operation, the system shall be disconnected, cleaned and reconnected wherever 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 Agency.

C. During the course of construction, all pipe and electrical conduits shall be capped in an approved manner to insure adequate protection against the entrance of foreign matter, moisture, etc.

3.13 CLEANING UP:

A. After completion of the work, remove all waste, rubbish and other materials left as a result of operations and leave the premises in clean condition.

B. All fixtures, equipment, etc. installed under the Mechanical and Electrical Sections shall be free of dirt, grease and other foreign material and left in perfectly clean condition and ready to use.

3.14 WARRANTY:

A. All parts of the work and all equipment shall be guaranteed for a minimum period of 18 months from the date of substantial completion. Please see section 01 78 30 for warranty requirements specific to the equipment or system.

B. If during that warranty period, any part of the work installed fails, becomes unsatisfactory or does not function properly due to any fault in material or workmanship, whether or not manufactured or job built, each section shall upon notice from the Agency, promptly proceed to repair or replace such faulty material or workmanship without expense to the Agency, including cutting, patching and painting or any other collateral work involved and including repair or restoration of any damaged sections of the premises resulting from such faults.

C. In the event, that a repetition of any one defect occurs, indicating the probability of further failure, and which can be traced to faulty product design, materials or workmanship, then repairs or replacement shall not continue to be made but, the fault shall be remedied by a complete replacement of the entire defective unit.

D. In addition to the general warranty, obtain and transmit to the Agency any guarantees or warranties from manufacturers of specialties but only as a supplement to the general warranty which will not be invalidated by same.

3.15 AGENCY'S INSTRUCTIONS AND SYSTEM OPERATION:

A. At the time of the job's acceptance by the Agency, the Contractor shall furnish one complete set of reproducible approved, certified as-built drawings to the Agency. In addition, Contractor shall furnish maintenance and operating instructions for all equipment including parts list.
These instructions shall be written in layman's language and shall be inserted in a vinyl covered three-ring loose leaf binder. All the information contained in the binder shall also be copied on a CD that will accompany the printed information. The information in the binder shall be first sent to be approved by the Architect/Engineer before turning over to the Agency.

B. Upon completion of all work and of all tests, this Contractor shall furnish the necessary skilled labor and helpers for operating the system and equipment for a period of four (4) days of eight (8) hours,. During this period, instruct the Agency or his representative fully in operation, adjustment and maintenance of all equipment furnished. Give at least forty-eight (48) hours notice to the Agency in advance of this period.

C. Contractor shall submit Instructions on CD-ROM of on-site video. Refer to Section 01 77 00, paragraph 1.5.G for additional requirements.

3.16 AGENCY'S ACCEPTANCE TEST:

A. After the various systems are complete as determined by preliminary operating tests, the Contractor shall arrange for the Agency's final acceptance tests.

B. The Contractor shall have present at each acceptance test, representatives of the several Contractors whose work is directly or indirectly involved, with instruments as necessary to validate proper performance in accordance with the design and to include the following:

1. All equipment installed and operating in accordance with manufacturer's instructions and performance guarantee.
2. All systems operating in accordance with specifications.
3. All distribution systems properly adjusted for distribution to equipment as specified.
4. The various systems properly flushed, cleaned, and free of entrapped air and dirt.
5. All motors installed with proper thermal overload protection and not operating under overload conditions as determined by ammeter readings.
6. All `as built` drawings, valve charts, etc. as specified in various parts of the specifications installed and/or ready for delivery to the Agency.

C. **THE DATE OF THE ISSUANCE OF A FORMAL CERTIFICATE OF SUBSTANTIAL COMPLETION SHALL BE THE START OF THE WARRANTY PERIOD. ALL WARRANTY PERIODS APPILCABLE TO THE WORK UDER THIS PROJECT ARE AS SPECIFIED BY SECTION 01 78 30 "WARRANTIES AND BONDS".**

3.17 TEST:

A. Conducting Tests: Conduct all tests called for under the various sections or as required and repair or replace any defects. Perform all tests in the presence of and to the satisfaction of the Engineer and such other parties as may have legal jurisdiction.

B. Defective Work: The Agency shall have the privilege of stopping any of the work not being properly installed. All such defective work shall be repaired or replaced and the tests shall be repeated.

C. Repair Damaged Work: Repair all damages resulting from tests and replace damaged materials.

END OF SECTION 23 05 00

ISSUED for BID

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.

B. The requirements in Section 23 05 00 shall also govern the work under this Section.

C. Examine all drawings and data and coordinate the work of this Section with all related and adjoining work.

D. Refer to sections 01 91 00, Commissioning, and 23 08 00, Commissioning of HVAC Systems, for work related to this section.

1.2 SCOPE OF WORK:

A. Provide all labor, materials, equipment and tools required to complete the work described and shown on the contract drawings.

B. Provide Air-Balance Report for Prerequisite IEQ 1: Documentation indicating that work complies with ASHRAE 62.1, Section 7.2.2 - "Air Balancing."

C. Provide TAB Report for Prerequisite EA 2: Documentation indicating that work complies with ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

PART 2 -PRODUCTS

2.1 PRODUCTS:

A. None required.

PART 3 - EXECUTION

3.1 GENERAL:

A. Work shall be performed only by a firm which employs certified testing, adjusting and balancing technicians as listed by the Sheet Metal Industry National Certification Board of TAB Technicians. The work may be performed by a certified Test, Adjusting and Balancing technician who may be assisted by other TAB technicians. This firm shall provide personnel trained and experienced in system balancing. This requirement will not be waived under any condition.

B. Before submitting system performance data for approval or acceptance, the firm shall perform all necessary tests and make all necessary adjustments as required to obtain the flow and distribution of air as called for on the Contract Documents.

C. The balance reports shall include the names, signatures and registration numbers of the technicians assigned to the project.

D. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

E. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.

F. Examine the approved submittals for HVAC systems and equipment.

G. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about HVAC system and equipment controls.

H. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.

I. Examine equipment performance data including fan and pump curves.

J. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

K. Examine test reports specified in individual system and equipment Sections.

L. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

M. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

N. Examine strainers. Verify that startup screens have been replaced by permanent screens with indicated perforations.

O. Examine control valves for proper installation for their intended function of throttling, diverting, or mixing fluid flows.

P. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

Q. Examine system pumps to ensure absence of entrained air in the suction piping.

R. Examine operating safety interlocks and controls on HVAC equipment.

S. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 ACCEPTABLE FIRMS:

A. The following listed firms are approved to perform this work:

Environmental Testing and Balancing
James Brennan Company
Technical Associates Group, Inc.
Wing's Testing and Balancing

B. Request to employ any other balancing and testing firm must be accompanied by a complete brochure of the firm listing previous installations successfully balanced, length of time in business, names and qualifications of employees and list of instruments available for use on the project.

3.3 AIR HANDLING SYSTEMS:

A. Prior to the start of balancing the firm shall check the rotation of all fans.

B. Check to verify that all backdraft dampers are free to open and close. All filters must be checked and, if dirty, they must be replaced before commencing balancing so as not to create excessive resistance to the system. The firm shall make any necessary changes in fan speed to obtain design system conditions and shall realign all belts when necessary.

C. This Section shall be responsible for identifying any necessary changes in pulleys and belts required to obtain proper air delivery and shall request additional dampers, splinters, turning vanes, turbulence vanes and other devices if necessary to obtain the correct air balance, all as directed by the Agency or his Representative.

This Contractor shall advice the Mechanical Contractor of the required corrections to the air distribution system, so that the system will perform as designed. All corrective work shall be done at no additional cost to the Agency.

D. The firm shall compile the following data for each air system insofar as they apply and shall include it on the final submittal:

FAN DESCRIPTIVE DATA

System Number
Location Served
Fan Size
Fan Make
Fan Horsepower
Motor Safety Factor
Heater Manufacturer & Size

FAN DESIGN & DELIVERED CONDITIONS

Fan Rpm
Motor Rpm
Total and/or external static pressure
Amperage
Voltage & Phase
Brake Horsepower
Cfm Supply
Cfm Return
Cfm Exhaust
Fresh Air Percent
Return Air Percent

SYSTEM DESIGN & DELIVERED CONDITIONS

Each outlet shall be identified as to location and area
Register or diffuser size
Register or diffuser factor
Register or diffuser free area, core area, or neck area
Design Cfm
Design Rpm
Final Rpm Reading
Final Cfm
Outlet manufacturer and type
Type of instrument and method used

E. The firm shall set all dampers of all types for proper air flow. No system causing objectionable air noise will be accepted. All hand volume dampers shall be marked at their final position. Balancing Contractor shall adjust blades on all the supply registers for the deflection indicated on drawings, so that the desired air circulation is achieved.

F. The firm shall provide all instruments and accessories required to perform the tests and shall make their own provisions for inserting the instruments. This section shall patch/plug all test holes that were made in the ducts/AHU/RTU/ERU to perform the test.

G. The firm shall notify the Agency's Representative when they will start work. Prior to this time, the firm shall send their supervising engineer to the office of the Agency or his Representative to review the design, desired operation, and method of balancing of the job.

H. Upon completion of the work, the firm shall certify that all systems are properly balanced and are delivering, returning or exhausting the required quantities. The firm shall deliver to the subcontractor five (5) copies of the test report for transmittal to the Agency's Representative.

I. Check all safety controls and record control sequences.

J. Check and record air temperatures.

K. Check scheduled air control record the operation by simulating complete operating cycle.

L. After completion of balancing, mark location of all final positions of dampers.

M. In addition to the above requirements, the final report shall include the following:

1. Static pressure reading across filters, coils, of each air handling system showing design and actual readings.
2. Measured suction, discharge and total static pressure for each fan.
3. Design and actual CFM from each outlet and return/exhaust.
4. Outside air, air on and off heating furnaces, air off cooling coils and terminal air supply temperatures for each air handling system.
5. Rated and actual motor current, in amperes, of every motor at full load conditions.

3.4 INSTALLATION TOLERANCES:

A. Adjust air handling systems to the following tolerances:

1. Supply systems shall be balanced so that:

a. The total quantity to each space is within -5% to +10% of design values.
b. If two outlets in space, each outlet is within -10% to +10% of design value.
c. If three or more outlets in space, each outlet is within -15% to +15% of design value.

2. Exhaust and return systems shall be balanced so the total quantity from each space is -10% to +10% of design values.

3.5 FIELD VERIFICATION:

A. The design Engineer may request verification of data contained in the balancing report. If requested the TAB technician whose initials appear on the data sheets shall take outlet and inlet readings selected at random by the Engineer who will compare these readings to those in the submitted report. If the field verification is not satisfactory, the firm doing the TAB work shall completely rebalance the system and a new report shall be prepared and submitted for approval.

END OF SECTION 23 05 93

ISSUED for BID

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including General and Supplementary Conditions and Division 01, General requirements, apply to the work specified in this Section.

B. The requirements in Section 23 05 00 shall also govern the work under this Section.

C. Scope of Work: This Section contains details for the insulation of pipe, ductwork and equipment installed under Division 23.

D. Refer to Section 01 78 30 “Warranties and Bonds” for warranty requirements applicable to the work of this section.

1.2 SUBMITTALS:

A. In accordance with Section 01 33 00, the following items shall be submitted for approval.

Ductwork insulation
Equipment insulation

B. Recycled Content: Provide data showing recycled materials content of materials and fabricated items provided for this project, stated as a percentage of the materials included in these items or materials provided as part of the Work of this Section.

C. Connecticut High Performance Building Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that product complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.3 MECHANICAL SYSTEMS INSULATION:

A. Furnish and install all thermal and protective insulation as specified herein for piping, ductwork and equipment as shown on the drawings.

B. The following mechanical items shall be insulated:
Ductwork, supply and outside air
Equipment insulation

1.4 SYSTEM PERFORMANCE

A. Insulation materials furnished and installed hereunder should meet the minimum thickness requirements of ASHRAE 90.1 (2015), "Energy Efficient Design of New Buildings," of the American Society of Heating, Refrigeration, and Air Conditioning Engineers. However, if other factors such as condensation control or personnel protection are to be considered, the selection of the thickness of insulation should satisfy the controlling factor.

B. Insulation materials furnished and installed hereunder shall comply with NFPA 255 and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with the following testing standard:

Underwriters' Laboratories, Inc. UL 723

Adhesives used for applying the sealed jackets shall also conform to these same ratings. The use of wheat paste or any other material not meeting these requirements will not be allowed.

1.5 QUALITY ASSURANCE

A. Insulation materials and accessories furnished and installed hereunder shall, where required, be accompanied by manufacturers' current submittal or data sheets showing compliance with applicable specifications.

B. Insulation materials and accessories shall be installed in a workmanlike manner by skilled and experienced workers who are regularly engaged in commercial insulation work.

C. All covering and insulating materials shall be manufactured by Johns Manville, Knauf, Owens-Corning or Armstrong.

1.6 DELIVERY AND STORAGE OF MATERIALS

A. All of the insulation materials and accessories covered by this specification shall be delivered to the job site and stored in a safe, dry place with appropriate labels and/or other product identification.

B. The contractor shall use whatever means are necessary to protect the insulation materials and accessories (wick material, sealing tape, etc) before, during, and after installation. No insulation material shall be installed that has become damaged in any way. The contractor shall also use all means necessary to protect work and materials installed by other trades.

PART 2 - PRODUCTS

2.1 DUCTWORK:

A. Insulate all plenums, intake ducts, air conditioning ducts, top housing of chilled beams and warm air supply ducts in concealed locations with 1" thick R-5, fiberglass faced duct wrap type IV with factory applied flame retardant foil reinforced Kraft (FRK-25 U.L. labeled).

B. Insulation shall be wrapped tightly on the ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum 2". Adhere insulation with 4" strips of Benjamin Foster 85-15 bonding adhesive at 8" o.c.

Additionally secure insulation to the bottom of concealed rectangular ductwork over 24" wide with suitable mechanical fasteners at not more than 18" o.c.

C. On circumferential joints, the 2" flame on the facing shall be stapled with 9/16" flare-door staples on 6" centers and taped with minimum 3" wide foil reinforced Kraft tape. On longitudinal joints, the overlap shall be stapled on 6" centers and taped with minimum 3" wide foil reinforced Kraft tape. All pin penetrations or punctures in facing shall also be taped.

D. Insulate air conditioning ducts or warm air ducts, all fresh air intake ducts, louver blanks, plenums in finished spaces or Boiler Room, with 1" thick, R-5, fiberglass ASJ-25 equipment insulation.

E. Insulation shall be cut to fit the shape and contour of the equipment. All voids between equipment surface and insulation shall be packed with light density fiberglass. Impale insulation over welded pins on 12" centers and secure in place with speed washers.

F. The insulation shall be vapor sealed to provide a complete airtight envelope. Vapor barrier shall consist of one layer of Ludlow Foil Barrier Paper smoothly adhered to the insulation or cement surface with Benjamin Foster 82-07 Vapor Barrier Lap Adhesive.

Lap all joints a minimum of 3" and seal with B.F. 82-07.

G. It is not necessary to cover exhaust ductwork, return duct or ductwork which is called for to be lined. However, exhaust and relief ductwork from motorized damper to exhaust louver shall be covered as called for above, or exhaust and relief ductwork located on cold side of building insulation shall be covered as called for above.

H. Supply ducts located in vented/unvented attic shall be insulated with duct insulation with min. R-8 value. Return ducts and exhaust ducts associated with energy recovery systems located in vented/unvented attics shall be insulated with R-5 insulation.

I. Cover ducts, exposed to outside weather, with Johns Manville 817 Series Spin-Glas rigid fiber glass board insulation, complying with ASTM C 612, Type II, rigid board, non- combustible, and meeting the following requirements:

1. Asbestos free.
2. Furnished in standard lengths and widths with ends cut square, conforming with the dimensional requirements of ASTM C 612, Types lA and 18.
3. Nominal density
   817 6.0 pcf (96 kg/m^3)
4. Maximum thermal conductivity, k (ksi), at
   817 0.22 (0.032)
5. Rated maximum service temperature: not less than 450°F (232°C).
6. Material shall have a flame spread no greater than 25 and a smoke developed no greater than 50 when tested as in accordance with ASTM E 84, UL 723 or

NFPA 255.

7. Vapor Retarder Jacketing: Aluminum foil reinforced with a glass fiber yam and laminated to fire- resistant kraft complying with ASTM C 1136 Type II. Cover outside insulated duct with VentureClad 1577CW jacketing system. Product shall have 10-year warranty.
8. UL listed, with UL compliance label on the carton.
9. Acceptable equals are by CertainTeed, Owens Corning or Knauf.

PART 3 – EXECUTION

3.1 SITE INSPECTION

A. Before starting work under this section, carefully inspect the site and installed work of other trades and verify that such work is complete to the point where installation of materials and accessories under this section can begin.

B. Verify that all materials and accessories can be installed in accordance with project drawings and specifications and material manufacturer's recommendations.

C. Verify, by inspecting product labeling, submittal data, and/or certifications which may accompany the shipments, that all materials and accessories to be installed on the project comply with applicable specifications and standards and meet specified thermal and physical properties.

3.2 PREPARATION

A. Ensure that insulation is clean, dry, and in good mechanical condition and that all factory-applied facings are intact and undamaged. Wet, dirty, or damaged insulation is not acceptable for installation.

B. Ensure that pressure testing of duct and fittings has been completed prior to installing insulation.

3.3 INSTALLATION

A. General

1. Install all insulation materials and accessories in accordance with manufacturer's published instructions and recognized industry practices to ensure that it will serve its intended purpose.

2. Install insulation on piping/duct subsequent to painting, and acceptance tests.

3. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over all piping surfaces.

C. Penetrations

Extend duct insulation without interruption through walls, floors and similar piping or duct penetrations.

3.4 SEAMS:

A. On exposed insulation, all longitudinal seams shall be kept at the top and back of the pipe and circumferential joints shall be kept to a minimum. Raw end of insulation shall be concealed by neatly folding the ends of the jackets. Fittings, valve bodies and flanges shall be furnished with the same jacket materials used on adjoining insulation.

3.5 PRIOR TESTING:

A. Covering shall not be applied until all parts of the work have been tested by the Contractor and reviewed by the Engineer.

3.6 METAL SHIELDS:

A. Metal shields, 16 gauge galvanized, shall be applied between hangers or supports and the pipe insulation. Shields shall be roll formed to fit the insulation and shall extend up to the center line of the pipe and the length specified for the insert. Insulation shall be rigid type for length of shield to prevent crushing.

3.7 FIELD QUALITY ASSURANCE

A. Upon completion of all insulation work covered by this specification, visually inspect the work and verify that it has been correctly installed. This may be done while work is in progress, to assure compliance with requirements herein to cover and protect insulation materials during installation.

B. Replace any ceiling damage caused by condensation due to improper covering and sealing during the guarantee period of this job.

3.8 PROTECTION

A. Replace damaged, removed or disturbed insulation with appropriate fiberglass insulation.

B. The insulation contractor shall advise the general and/or the mechanical contractor as to requirements for protection of the insulation work during the remainder of the construction period, to avoid damage and deterioration of the finished insulation work.

3.9 SAFETY PRECAUTIONS

A. Insulation contractor's employees shall be properly protected during installation of all insulation. Protection shall include proper attire when handling and applying insulation materials, and shall include (but not be limited to) disposable dust respirators, gloves, hard hats, and eye protection.

B. The insulation contractor shall conduct all job site operations in compliance with applicable provisions of the Occupational Safety and Health Act, as well as with all state and/or local safety and health codes and regulations that may apply to the work.

END OF SECTION 23 07 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including General and Supplementary Conditions and General Requirements, apply to the work specified in this Section.

B. The requirements in Section 23 05 00 shall also govern the work under this Section.

C. Examine all drawings and data and coordinate the work of this Section with all related and adjoining work.

D. Refer to sections 01 91 00, Commissioning, and 23 08 00, Commissioning of HVAC Systems, for work related to this section.

E. Refer to Section 01 31 00 “Project Management and Coordination” for requirements for coordination drawings applicable to the work of this section.

F. Refer to Section 01 45 23.13 “Testing for Indoor Air Quality, Baseline IAQ and Materials” for requirements applicable to the work of this section.

G. Refer to Section 01 57 40 “Construction Indoor Air Quality Management Plan” for requirements applicable to the work of this section.

H. Refer to Section 01 81 13.13 “Requirements for Connecticut High Performance Buildings” for requirements applicable to the work of this section.

1.2 SCOPE OF WORK:

A. Contract includes all labor, material, equipment accessories and test required to furnish and install all air distribution systems as shown on drawings, implied and herein specified, complete and ready to operate.

B. Contractor is requested to examine all of the Architectural plans and all details of construction and visit the site of the proposed addition and alterations so as to thoroughly acquaint himself with all conditions before submitting his bid.

C. Work shall include but is not limited to the following:

1. Ductwork
2. Exhaust Fans
3. Air Handling Units

D. Contractor shall be responsible for wiring of all temperature controls.

1.3 SUBMITTALS:

A. Refer to Section 01 33 00 “Submittal Procedures”.

B. Submit shop drawings, test data and product data for the following :
Ductwork
Fans
Grilles and Diffusers
Fan Dampers
Access Doors

B. Recycled Content: Provide data showing recycled materials content of materials and fabricated items provided for this project, stated as a percentage of the materials included in these items or materials provided as part of the Work of this Section.

1.4 AIR DISTRIBUTION SYSTEM DESCRIPTION:

A. Furnish and install all supply, return and exhaust air system as indicated on the drawings. Systems to be complete with fans, motors, controls, starters, unless otherwise specifically omitted, ducts, filter banks, registers, grilles, diffusers, vibration eliminating bases, balancing dampers, fire dampers, automatic dampers, acoustical lining, insulation and other accessories to make the system complete and ready to operate to the full intent of the plans and specifications. The capacities and characteristics of fans, air handling equipment, shall be as indicated on the drawings.

B. All ductwork shall be run on warm side of building insulation.

C. Design is based on equipment as described in the drawing equipment schedules. Any changes in foundations, connections, piping, controls, electrical equipment, wiring and connections and openings required by alternate equipment submitted and approved shall be made at no additional cost to the Agency.

PART 2 - PRODUCTS

2.1 DUCTWORK:

A. All sheet metal used throughout, except as specifically noted, shall be constructed of galvanized steel sheets as follows:

Rectangular Ducts		Alum.	Copper	
Duct up to 12"		26 ga.	24 ga.	16 oz.
Duct 13" to 30"		24 ga.	22 ga.	24 oz.
Duct 31" to 60"		22 ga.	20 ga.	32 oz.
Duct 60" and beyond	20 ga.			
Casings up to 72"	16 ga.			
Casings beyond 72"	14 ga.			

Bracings for Ducts

Up to 24" None

25" to 40 1" x 1" x 1/8" 4 ft. from joint
41" to 60" 1-1/2" x 1-1/2" x 1/8" 4 ft. from joint
61" to 90" 1-1/2" x 1-1/2" x 1/8" diagonal angles
or 1-1/2" x 1-1/2" x 1/8" angles 2 ft. from joint

B. All fittings, joints, seams and connections shall be made up in accordance with standard recommended practice as described in Air Duct Design, latest ASHRAE Guide and SMACNA Low Pressure Standards, using Class B construction with all seams sealed. Snap lock joints will not be permitted.

2.2 MEDIUM PRESSURE ROUND DUCT:

A. All medium pressure and round ductwork shall be manufactured by the same firm to assure tight fit of all ductwork and components. Provide ductwork in United McGill or Semco.

B. Submit the round duct test data covering leakage rate, bursting strength, collapsing strength, seam strength, and friction loss. Friction loss test data shall cover both the duct and the assembled coupling joints. This friction loss data used in the design of this system, include information on fittings used in system.

C. Round and oval duct shall be manufactured of galvanized steel meeting ASTM A-525 and A-527-67 by the following methods and in the minimum gauges listed:

Diameter	Minimum Gauge	Method of Manufacture
3" thru 14"	24 Ga.	Longitudinal Seam
15" thru 26"	22 Ga.	Longitudinal Seam
27" thru 36"	20 Ga.	Longitudinal Seam
37" thru 50"	20 Ga.	Longitudinal Seam
51" thru 60"	18 Ga.	Longitudinal Seam
61" and Up	16 Ga.	Longitudinal Seam

Longitudinal seam duct shall have a fusion-welded butt seam.

D. Fittings and couplings shall be of the following minimum gauges:

Diameter	Gauge
3" thru 36"	20 Gauge
38" thru 50"	18 Gauge
Over 50"	16 Gauge

1. All fittings are to have continuous welds along seams. All divided flow fittings are to be manufactured as separate fittings, not as tap collars welded into spiral duct sections.
2. All 90 degrees tees and 45 degrees laterals (wyes) up to and including 12" diameter tap size shall have a radiused entrance into the tap, produced by machine or press forming. The entrance shall be free of weld buildup, burrs, or irregularities.
3. Elbows in diameters 3" through 8" shall be two section stamped elbows. All other elbows shall be gored construction with all seams continuous/welded.
4. Where it is necessary to use 2-piece mitered elbows, they shall have turning vanes in accordance with the following schedule.

Diameter	Number of Vanes
3" thru 9"	2
10" thru 14"	3
15" thru 19"	4
20" thru 60"	5
Over 60"	12" Spacing

E. Registers to be mounted directly to duct shall be provided with boots for mounting to round spiral duct.

F. Galvanized areas that have been damaged by welding shall be coated with corrosion resistant aluminum paint.

G. Pipe-to-pipe joints in diameters to 36" shall be by the use of sleeve couplings, reinforced by rolled beads. Use welded angles for 37" diameter and above.

2.3 FLEXIBLE AIR DUCT:

A. Flexible air ducts shall be used to connect supply ducts with air distribution outlets where shown. Flexible air ducts shall be all metal construction consisting of a bonded two ply laminate mechanically corrugated for strength and air tightness and shall be able to withstand 12" W.G. pressure.

Flexible air duct shall be of semi- rigid construction capable of being easily hand preformed without subsequent sagging or droop. Duct connections to equipment outlet collars shall be made in accordance with the duct manufacturer's recommendations. Insulated flexible duct shall be Clevaflex Type 12 as manufactured by Clevepak Corporation, New York, New York 10022, or approved equal in Metalaire.

B. Flexible duct shall meet the requirements or NFPA 90A.

C. All flexible duct shall be preinsulated. The maximum length of flex duct shall not exceed 6’-0”.

2.4 JOINT SEALING:

A. Round duct joints in diameter through 60" shall be assembled and sealed as follows:

B. Approved sealer is applied to the male end of the couplings and fittings. After the joint is slipped together, sheet metal screws are place 1/2" from the joint bead for mechanical strength. Sealer is applied to the outside of the joint extending 1" on each side of the joint bead and covering the screw heads. Plastic-backed tape is immediately applied over the wet sealer.

C. The duct sealer must be specifically formulated for the job of sealing the field joints for high pressure systems. The sealer shall be compatible with plastic-backed duct tape so the two shall cure and bond together. Samples of sealer and tape and the specification data sheets shall be submitted to the engineer for approval.

D. Flanged joints shall be sealed by Neoprene Rubber gaskets.

2.5 ACCESS DOORS IN DUCTWORK:

A. Furnish hinged and reinforced access doors with wire glass observation port in door in sheet metal work for observation or maintenance of all dampers, controls in sheet metal ducts and housings. This applies to fresh air ducts, exhaust ducts, etc. Furnish doors of tight fitting construction. All duct access doors shall be furnished in Ventlok or equal in Air balance, Advanced Air, Inc. or Louvers & Dampers, Inc.

B. For access doors in architectural finishes refer to Section 08 31 16.

2.6 VOLUME DAMPERS:

A. Volume dampers with locking quadrants shall be provided on all supply, exhaust and return ducts, on all branches and at all take-off's to registers and diffusers.

B. Dampers shall be constructed of #20 gauge steel properly stiffened and to have locking quadrants outside covering of ducts. Opposed blade multi-lead dampers shall be used wherever damper blade is larger than 12".

2.7 REGISTERS, GRILLES AND DIFFUSERS:

A. Registers, grilles and ceiling diffusers shall be furnished of size and type as shown on drawings, in Titus and Seiho or equal in Krueger or Price. The cat. no.'s refer to equipment as manufactured by Titus.

B. All registers and wall grilles furnished in steel shall be furnished in prime coat except where specified herein or shown on drawings to be aluminum construction or factory baked enamel. Color shall be selected by the Architect. Color shall be applied at the factory.

C. Refer to schedule on drawings for type and finish of each grille.

D. Provide all wall grilles and registers with all purpose frame.

E. All registers and diffusers shall be compatible with ceiling specified under Architectural.

2.8 ROOF EXHAUST FANS:

A. This Contractor shall furnish and install all power roof ventilators and wall fans (exhaust fans) complete with starters and controls, in accordance with schedule shown on plans, with weatherproof motors and controls where located in the air stream.

B. Furnish disconnect switches, factory mounted, in housing with flexible heavy duty cords to motor with extra grounding wire, color coded.

C. The capacities of all power roof ventilators are based on Cook make and power roof ventilators shall be furnished in this make or approved equal in Acme or Greenheck. All fan housings shall be furnished with base in heavy gauge aluminum, unless otherwise indicated. Provide adjustable pulleys. Fans shall have AMCA certified ratings.

D. Provide 18" high companion pre-fabricated sound curb as called for in schedule.

2.9 FAN DRIVES:

A. Furnish each V-belt drive with variable pitch motor pulley unless otherwise specified.

B. Fan manufacturer shall furnish factory standard belt guard for all exposed drives. Field constructed guards will not be approved. Furnish all belt guards with prime coat.

2.10 CANVAS JOINTS:

A. On each side of each centrifugal or centriline fan and at each air handling unit having duct connections, furnish Ventfabric Tape for expansion and elimination of sound travel in ductwork.

B. Furnish and install Doro-Dyne Insuflex, insulated flexible duct connector at all locations where the duct crosses an expansion joint.

2.11 OUTSIDE WALL LOUVERS:

A. All outside louvers for air handling units, fan inlets and exhaust fan outlets in outside wall shall be furnished complete with 1/2" mesh aluminum screens.

B. On outside air intake louvers serving air handling units, provide manual opposed blade balancing damper between louver and motorized damper.

2.12 VIBRATION ISOLATION:

A. All mechanical equipment shall be mounted on or suspended from approved and specified foundations and supports.

B. All floor mounted equipment shall be erected on 6" high reinforced concrete house - keeping pads (by Division 3)

C. All vibration isolation systems shall be guaranteed to have the static deflections required to warrant a 98% isolation efficiency. The vibration isolation system shall be installed in accordance with the manufacturer's instructions.

PART 3 - EXECUTION

3.1 GENERAL FOR EQUIPMENT:

A. Refer to schedule on drawings for size, type, design capacities and characteristics of Air Handling Units, Fans and Unit Heaters. Also required accessories shall be indicated in schedule or listed herein.

B. Provide and install all additional structural supports for fans, and air handling equipment, not provided for by the General Contractor.

C. Provide and install vibration eliminators of type and size approved and recommended by the manufacturer for the particular application and arrangement of installation.

D. Provide and install flexible joints on either side of fan.

E. Furnish all combination disconnect switches and starters for fans unless otherwise called for.

F. This Contractor is responsible for all internal wiring between separate air handling equipment sections.

G. All equipment on base drawings, including roof top units, have been dimensionally coordinated with the architectural and structural drawings. If this Contractor proposes to substitute any equipment other than which is on the basic bid drawings, for review, he shall first verify that the proposed equipment will fit dimensionally.
This Contractor shall be responsible for any additional costs to changes incurred because of the above substitution even after review by the Engineer.

H. Provide service disconnect switches mounted on all rooftop equipment.

3.2 STRUCTURAL SUPPORT:

A. Main dunnage steel shall be provided under another section; however, this Contractor shall provide all supplementary steel for the complete support of equipment.

3.3 DESCRIPTION OF SUPPLY AND RETURN AIR/EXHAUST SYSTEM:

A. Furnish and install the complete horizontal and vertical ducts for each system between all AHU's , and registers and grilles. For all centrifugal fans, furnish flexible joints either side of fan and extend the fan discharge ducts to wall openings and louvers or other openings as indicated; near wall outlet provide hinged access door with lock for access to damper.

B. Friction dampers shall be installed in all branch ducts made accessible for adjustment near registers or grilles. For exact type of grilles or registers, refer to drawings.

C. Furnish angle frames to suit construction for all registers and grilles complete with plaster stops.

D. Furnish on each fresh air intake an opposed blade manual damper between louver and motorized damper.

E. Sizes and approximate locations of all ducts are shown on the drawings. Check carefully with the architectural and structural drawings and drawings showing work of other trades to make sure that there will be no conflict between these trades and the ducts.

F. Coordinate the installation of setting frames and registers in order that details as shown on drawings are adhered to. Wood rounds shall be furnished and installed as shown on architectural detail.

G. All ductwork shall be installed as shown on drawings and is to be rigidly braced and supported to prevent vibration and sagging.

H. All hangers and supports are to be fastened securely to concrete, wood or steel construction. Under no circumstances will hangers be inserted supported on suspended ceilings, conduits or pipe be permitted.

I. All vertical ducts shall be supported at each floor level by means of angle iron riveted securely to ducts.

J. Refer to Section 01 31 00 for coordination drawings.

K. This Contractor is responsible for performing a minimum two-week building flush-out with new filtration media and 100% outside air, after the end of construction and prior to occupancy. Filtration media shall have a Minimum Efficiency Reporting Value (MERV) of 13. When performing the flush-out, the temperature control system shall be operational so that the outside air can be tempered. All coils, fans and filters shall be cleaned before performing testing and balancing. Provide new filter media with a MERV of 13 for all Air Handling Unit Systems, after the flush-out period and prior to occupancy.

L. Contractor shall provide all labor and materials as required to assist the Balancing Contractor in proper balancing of the air systems. Contractor shall return to the job and shall make the necessary adjustments and corrections to the systems as required by the Balancing Contractor in order to achieve satisfactory system performance in accordance with design parameters.

M. This Section shall be responsible for any necessary changes in pulleys and belts required to obtain proper air delivery and shall provide additional dampers, splinters, turning vanes, turbulence vanes and other devices if necessary to obtain the correct system performance, all as directed by the Agency's or its Representative.

END OF SECTION 23 31 13

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including Division 0, Contract Requirements, and Division 1, General Requirements, are a part of this Section and shall be binding on the Contractor and /or Subcontractor who performs this work. Note also all addenda.

B. The requirements in Section 26 00 00 shall govern the work under all Sections of Divisions 26, 27, and 28.

C. Section 01 20 00 “Contract Considerations – CMR” for unit prices applicable to Divisions 26, 27, and 28.

D. Section 01 78 30 “Warranties and Bonds – CMR” for warranty requirements applicable to Divisions 26, 27, and 28.

E. Refer to section 01 91 00, Commissioning, and 26 08 00, Commissioning of Electrical Systems, for work related to this section.

1.2 SCOPE OF WORK:

A. Scope of work consists of installation of materials to be furnished under these Specifications and without limiting generality thereof consists of furnishing labor, materials, equipment, hoisting, plant, transportation, rigging, staging, appurtenances, and services necessary and/or incidental to properly complete all electrical work as shown on drawings, as described in the Specifications or as reasonably inferred from either as being required in opinion of the Architect and Engineer.

B. Work Included: Provide complete electrical services where shown on the drawings, as specified herein and as needed for a complete and proper installation including but not necessarily limited to:

1. Temporary power (see Division 1).
2. Switchgear, panelboards and transformers.
3. Complete feeder distribution system to various distribution, lighting, power and computer power panels.
4. Complete branch circuit wiring system for lighting, motors, receptacles, and other noted loads.
5. Lighting fixtures.
6. Site lighting standards.
7. Sports lighting.
8. Concrete bases and foundations for site lighting standards and sports lighting.
9. Occupancy sensor lighting controls.
10. Switches, receptacles, and other similar wiring devices.
11. Raceways and boxes for telephone, data, catv outlets, audio/visual (A/V) outlets, security/access control devices.
12. Lightning protection.
13. Fire alarm system.

14. Intercom/paging system/clocks.
15. Vibration isolation and seismic restraints for electrical equipment.

1.3 SITE CONDITIONS:

A. Prior to submitting bid, visit the site and identify existing conditions and difficulties that will affect work called for by the Contract Documents.

B. No compensation will be granted for additional work caused by unfamiliarity with site conditions that are visible or readily construed by experienced observers.

C. The Contractor shall verify and obtain all necessary dimensions at the site.

1.4 DEFINITIONS:

A. Furnish: The word "furnish" is used to mean "supply and deliver the referenced item to the project site, ready for unloading, unpacking, assembly, and installation".

B. Install: The word "install" is used to describe operations at the project site involving the referenced item including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations".

C. Normally Occupied: The words "normally occupied" are used to mean "all rooms within a building except for crawlspaces, underground tunnels, attic spaces, mechanical rooms, telephone rooms, data distribution rooms, and electrical rooms".

D. Or Approved Equal: The words "or approved equal" are used to mean "any product which in the opinion of the Engineer is essentially equal in quality, size, arrangement, appearance, construction, and performance to that product specified or shown on the drawings".

E. Provide: The word "provide" means "to furnish and install the referenced item, complete and ready for the intended use".

F. Remove: The word "remove" means "to disconnect from its present position, remove from the project site, and to dispose of in a legal manner".

1.5 QUALITY ASSURANCE:

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of the Contract Documents.

B. Codes and Regulations:

1. In addition to complying with the specified requirements, comply with all Federal, State and Local Codes wherever applicable including the following: 2018 Connecticut State Building Code, 2015 IBC, 2018 Connecticut Fire Safety Code , 2015 International Fire Code, 2013 NFPA 72 National Fire Alarm Code, 2017 NFPA 70 National Electrical Code, 2010 NFPA 110 Standard for Emergency and Standby Power Systems, 2015 International

Energy Conservation Code, ICC/ANSI A117.1-2009 Accessible and Usable Buildings and Facilities, and ADA.

2. Comply with the requirements of the Local Authority Having Jurisdiction.
3. Materials and equipment shall be UL listed where standard has been established.
4. Perform tests required by specifications, Engineer's instructions, laws, ordinances or public authorities, approvals, and give Owner timely notice. Notify the Owner of dates for inspection by other authorities.
5. In the event of conflict between or among specified requirements and pertinent regulations, the more stringent requirement will govern.
6. Reference made to codes and standards shall be interpreted as minimum requirements. Provide and perform work in excess of codes and standards as indicated by drawings or specifications.

1.6 SUBMITTALS:

A. Comply with the requirements of Division 1 for submittal procedures.

B. Comply with the submittal requirements in Specification Section 01 81 00, Building Commissioning Requirements.

C. Submittals, shop drawings, and samples will be reviewed with reasonable promptness and will be stamped indicating appropriate action as follows:

1. “No Exceptions Taken” means that fabrication, manufacture, or construction may proceed providing submittal complies with contract documents.

2. “Amend as Noted” means that fabrication, manufacture, or construction may proceed, providing the submittal complies with Engineer’s notations and contract documents.

3. “Resubmit” means that submittal, or equipment proposed to be provided, does not comply fully with the contract documents and that fabrication, manufacture, or construction shall not proceed. Resubmit in accordance with the Engineer’s notations and contract documents.

4. “Rejected” means that submittal does not comply with contract documents, or that equipment proposed to be provided does not comply with the specified requirements or is not equal or better in quality and performance than that item specified. Fabrication, manufacture, or construction shall not proceed. Resubmit in accordance with the contract documents and specified requirements.

1.7 AS-BUILT DRAWINGS:

A. Comply with requirements of Section 01 77 00.

B. Maintain a clean, undamaged set of black line white-prints of Contract Drawings and Shop Drawings at the job site. Protect as-built drawings from deterioration and loss in a secure location. Provide access to as-built drawings for reference during normal working hours by the Owner, Architect, Engineer, and Authority Having Jurisdiction.

C. As work progresses mark the As-built drawings to show the actual installation where the installation varies from the work as originally shown, whether resulting from Addenda, Change Order, approved submittals, or changes made due to field conditions. Mark whichever drawing is most appropriate for showing conditions fully and accurately. Where shop drawings are used, record a cross reference at the corresponding location on the Contract Drawings. Give particular attention to items concealed within the structure or buried below grade.

1.8 OPERATING AND MAINTENANCE MANUALS:

A. Comply with requirements of Section 01 77 00 and as follows:

B. Upon completion of the work of this Contract, deliver to the Architect and Engineer four (4) copies of an Operation and Maintenance (O & M) Manual. Organize operating and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual heavy-duty 2-inch, 3-ring vinyl covered binders, with pocket folders for folded sheet information. Include a separate section for each system or sub-system. Sections shall be separated by heavy plastic dividers with tabs that identify the material in each section. Place a permanent label or title block on each binder for identification.

1.9 GUARANTEE AND WARRANTIES:

A. Obtain in Owner's name written equipment and material warranties offered in manufacturer's published product data without exclusion or limitation.

B. Guarantee work of this Contract in writing for the warranty period as specified by Section 01 78 30 "Warranties and Bonds – CMR". Repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to Owner's satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within contract price.

1.10 LAWS, ORDINANCES, PERMITS, AND FEES:

A. Give all necessary notices, obtain all permits and pay all taxes, fees and other costs in connection with the work; file all necessary plans, prepare all documents and obtain all necessary approvals of all Regulation Authorities; obtain all required Certificates of Occupancy and/or Inspections required for the work and deliver same to the Owner before requests for acceptance and final payment for the work.

1.11 CORRELATION OF DRAWINGS AND SPECIFICATIONS

A. In general, the Specifications will describe the "quality" of the work and the Drawings the "extent" of the work. The Drawings and Specifications are cooperative and supplementary; however, and each item of the work is not necessarily mentioned in both the Drawings and Specifications. All work necessary to complete the project, so described, is to be included in this contract.

1.12 ELECTRICAL VOLTAGES:

A. The electrical service to the building is 480Y/277V, 3 phase, 4 wire with local transformation to 208Y/120V, 3 phase, 4 wire.

B. All equipment shall be suitable for this electrical supply. It is the responsibility of the Contractor to study the electrical drawings to determine the supply for any particular piece of equipment.

1.13 BUILDING COMMISSIONING:

A. Comply with the building commissioning requirements in Section 01 81 00, Building Commissioning Requirements.

PART 2 - PRODUCTS

2.1 MATERIALS AND WORKMANSHIP:

A. Provide only materials that are new and of type and quality specified. Where Underwriters' Laboratories, Inc. have established standards for such materials, provide only materials bearing the UL label.

B. Provide accessories, materials and equipment necessary to make installation complete in every detail, and to conform to manufacturers' latest installation instructions, under this Contract whether or not specifically shown on drawings or specified herein.

2.2 PROTECTION:

A. Work performed by the Contractor shall include protecting the work and materials of all other Contractors from damage by work or workmen, and shall include making good any and all damage thus caused.

2.3 TEMPORARY FACILITIES:

A. Provide temporary power and lighting as specified under Division 1, and as required for the performance of the work of this Contract.

B. Provide new materials and equipment; if acceptable to the Architect, undamaged previously used materials in serviceable condition may be used. All materials shall be suitable for the service intended.

2.4 SCAFFOLDING, RIGGING, HOISTING:

A. Work shall include all scaffolding, rigging, hoisting and services necessary for delivery and erection of equipment into or onto the site and/or building. Remove all scaffolding, rigging, and hoisting equipment from the site when no longer needed.

2.5 EXCAVATION AND BACKFILLING:

A. Excavation and backfilling for all electrical work inside and outside of the building shall be performed in accordance with Division 31 of these Specifications.

2.6 CUTTING AND PATCHING:

A. Cutting and patching for all electrical work shall be performed in accordance with Division 1 of these Specifications.

2.7 SLEEVES AND OPENINGS:

A. The Electrical Contractor shall provide all necessary sleeves and openings as required to permit the installation of the electrical systems.

2.8 PAINTING:

A. All painting of electrical work shall be performed in accordance with Division 9 of these Specifications, unless otherwise specified.

2.9 ELECTRICAL MOTOR STARTERS AND VARIABLE FREQUENCY DRIVES (VFD'S):

A. Motor starters and variable frequency drives (VFD'S) shall be furnished by each respective trade for motor driven equipment provided by them. The Electrical Contractor shall install the starters and VFD'S, and shall provide all power wiring to the starters and VFD'S, and from the starters and VFD'S to the motors they control.

2.10 BASES AND SUPPORTS:

A. Provide all necessary supports, rails, framing, bases, and piers required for the installation of equipment provided under this contract.

2.11 SEISMIC RESTRAINTS:

A. Provide seismic restraints for all electrical system components in accordance with the 2018 Connecticut State Building Code.

2.12 SLEEVES, INSERTS AND ANCHOR BOLTS:

A. The Contractor shall provide and shall be held responsible for the location and position of all sleeves, inserts, and anchor bolts required by his work. Failure to do so, which requires cutting and patching of finished work, shall be done at no additional cost to the Owner.

2.13 FIRE STOPPING:

A. Fire stopping for electrical penetrations through rated assemblies shall be provided under Division 7 of these specifications by a licensed Contractor specializing in the installation of firestop systems.

2.14 LUBRICATION:

A. All equipment installed under this contract having moving parts shall and requiring lubrication shall be properly lubricated according to the manufacturer's instructions prior to operation and testing. Any such equipment discovered to have been operated prior to lubrication by the Contractor shall be subject to rejection and replacement at no additional cost to the Owner.

2.15 ACCESS PANELS:

A. Provide access panels for electrical equipment which is not readily accessible. Such equipment includes items above hung ceilings which are not readily removable and items installed within walls, inside chases, or inside dead cavity spaces. Access panels shall comply with the requirements of Section 08 31 16.

2.16 OTHER MATERIALS:

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect and Engineer.

PART 3 - EXECUTION

3.1 GENERAL:

A. Unless specifically noted or shown otherwise, install all equipment and material specified herein or shown on drawings whether or not specifically itemized herein.

3.2 SURFACE CONDITIONS:

A. Examine the areas and conditions under which work of this Contract will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.3 PREPARATION:

A. Coordinate:

1. Coordinate as necessary with other trades to assure proper and adequate provisions in the work of those trades for interface with the work of this Contract. Each Contractor shall furnish all information necessary to permit work of other trades to be installed in a satisfactory manner.

3.4 ACCESSIBILITY:

A. Locate all equipment which must be serviced, operated or maintained, in fully accessible positions including but not limited to: controllers, motor starters, disconnect switches, transformers, panelboards, switchgear, etc. Provide access panels as required for equipment access.

3.5 CLEANING AND PROTECTING PIPING, CONDUITS AND EQUIPMENT:

A. Thoroughly clean all piping, conduit, and equipment of all foreign substances inside and out before installation.

3.6 PROJECT COMPLETION:

A. Upon completion of the work, remove all waste, rubbish and other materials left as a result of operations and leave the premises in clean condition.

B. Thoroughly clean all exposed portions of the electrical installation, removing all traces of soil, labels, grease, oil and other foreign material, and using only the type cleaner recommended by the manufacturer of the item being cleaned.

C. Vacuum all exteriors of equipment and interiors of equipment having accessible interior compartments to remove all dust, dirt, cable clippings, construction debris, etc.

3.7 INSTRUCTION PERIOD:

A. Prepare written instruction frames for the proper maintenance and operation of any special equipment furnished and installed under this Contract.

B. The contractor shall arrange for on-site instruction of the Owner's representatives by manufacturers of all major items of equipment. The instruction periods shall be consecutive and shall be held after the installations are complete, tested and balanced and the approved documentation is available. The contractor shall be responsible for attendance of the manufacturer's technical representatives and shall coordinate program timing with the Owner.

C. In addition to normal operation, the Owner's representatives shall be instructed on routine maintenance and trouble-shooting.

END OF SECTION 26 00 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including Division 0, Contract Requirements, and Division 1, General Requirements, are a part of this Section and shall be binding on the Contractor and /or Subcontractor who performs this work. Note also all addenda.

B. Section 26 00 00 General Electrical shall also govern the work under this Section.

C. This Section includes requirements that are binding on other Sections of Divisions 26, 27, and 28.

1.2 SCOPE OF WORK:

A. Scope of work consists of installation of materials to be furnished under this Section, and without limiting generality thereof consists of furnishing labor, materials, equipment, hoisting, plant, transportation, rigging, staging, appurtenances, and services necessary and/or incidental to properly complete all electrical work as shown on the drawings, as described in these specifications or as reasonably inferred from either as being required in opinion of the Architect and Engineer.

B. Work Included: Provide complete electrical services where shown on the drawings, as specified herein and as needed for a complete and proper installation including but not necessarily limited to:

1. General
2. Conduits, Raceways
3. Equipment Labeling
4. Wire and Cables
5. Devices, Switches and Receptacles
6. Outlet Boxes, Junction Boxes, Pull Boxes, Wireways
7. Cabinets
8. Disconnect Switches
9. Supporting Devices
10. Fuses
11. Grounding
12. Backboards.

1.3 QUALITY ASSURANCE:

A. Refer to Section 26 00 00.

1.4 SUBMITTALS:

A. Shop Drawings, Product Data, and Certifications that products conform to requirements: Submit for all items provided as part of the Work of this Section, including but not limited to those items listed in Paragraph 1.2, B above.

PART 2 - PRODUCTS

2.1 GENERAL:

A. Provide only materials that are new and of type and quality specified, or approved equal. Where Underwriters' Laboratories, Inc. have established standards for such materials, provide only materials bearing the UL label.

2.2 TEMPORARY FACILITIES:

A. Refer to the requirements of Division 1 regarding temporary facilities.

2.3 RACEWAYS:

A. Rigid Steel Conduit:

1. Shall be manufactured from high strength strip steel, shall be hot dipped galvanized with threads galvanized after cutting, and shall be chromated to form an additional protective layer. Rigid steel conduits shall be UL listed, shall meet the requirements of ANSI C80.1, and shall be as manufactured by Allied Tube and Conduit, Wheatland, or Calconduit.

B. Rigid PVC Conduit:

1. Shall be heavy wall schedule 40 PVC for underground work and extra heavy wall schedule 80 PVC for underground work below vehicular traffic areas. Joints and fittings shall be solvent welded all to ASTM standards for underground installation and in accordance with Article 352 of the National Electric Code.

C. Intermediate Steel Conduit:

1. Shall be manufactured from high strength flat steel that is cold-formed and electrically welded into a uniform tube, shall be hot dipped galvanized with threads galvanized after cutting, and shall be chromated to form an additional protective layer. Intermediate steel conduit shall be UL listed, shall meet the requirements of ANSI C80.6, and shall be as manufactured by Allied Tube and Conduit, Wheatland, or Republic Conduit.

D. Electrical Metallic Tubing:

1. Shall be manufactured from high grade mild strip steel, shall be hot dipped galvanized, and shall be chromated and lacquered to form additional protective layer. EMT conduit shall conform to UL 797 and ANSI C80.3 and shall be as manufactured by Allied Tube and Conduit, Wheatland, or Republic Conduit.
2. Connectors and couplings shall be galvanized steel set screw type. Provide gland compression type couplings and connectors for exposed work in wet locations.

E. Flexible Steel Conduit:

1. Shall be full wall steel flexible conduit, shall be manufactured from high grade strip steel and shall be hot dipped in a molten zinc bath. The steel strip shall be formed into interlocking convolutions that are continuously joined, metal to metal, assuring continuous

grounding contact. Flexible steel conduit shall be UL listed and shall be as manufactured by AFC Cable Systems, Greenfield, Anaconda, or Electri-Flex.

2. Flexible steel conduit fittings shall be zinc plated malleable iron squeeze type connectors and zinc plated malleable iron combination couplings

F. Liquidtight Flexible Steel Conduit:

1. Shall be similar to flexible steel conduit, but with pressure-extruded moisture and oil-proof outer jacket of gray polyvinyl chloride plastic. Liquidtight flexible steel conduit shall be UL listed (UL 360) and shall be as manufactured by AFC Cable Systems Anaconda, or Electri-Flex.
2. Fittings, couplings and connectors shall be threaded, zinc plated, malleable iron liquidtight type.

G. Surface Steel Wireway:

1. Wireways shall be code gauge galvanized steel, manufactured standard sections and fittings, with hinged and/or screw covers, indoors NEMA Type 1/Outdoors NEMA Type 3R, and shall be manufactured by Hoffman, Cooper, Square D, or Wiremold. Wireways shall be sized to code conductor fill requirements and shall be provided as required for job conditions.

2.4 METHODS AND MATERIALS FOR LABELING EQUIPMENT:

A. Switchboards, Switchboard Circuit Breakers, Panelboards, Safety Switches, Transfer Switches, Remote Control Switches, Lighting Contactors, Lighting Control Panels:

1. Non-metallic engraved nameplates shall be used to identify device. Nameplates shall be secured to equipment with two screws or rivets. Adhesive nameplates are not acceptable.
2. Letters shall be white on black background.
3. Nameplate letters shall be 1/4" high.
4. Identification nomenclature shall be in accordance with plans. All name nomenclature shall be submitted for approval.
5. Nameplates for switchboards and panelboards shall include panel designation and voltage.

2.5 SAFETY SWITCHES:

A. All safety disconnect switches shall be furnished in heavy duty quick-make, quick-break, interlocking fusible or non-fusible, type as indicated on the drawings. Manufacturer shall be the same as provided for switchgear and panelboards.

B. Provide enclosures clearly marked for maximum voltage, current and horsepower rating, and:

1. Indoors: NEMA Type 1.
2. Outdoors or Damp or Wet Locations: NEMA Type 3R.
3. Hosedown and Splashing Water Locations: NEMA Type 4.

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2.6 MOTOR STARTER/DISCONNECTS AND VFD'S:

A. Combination motor starter/disconnects and variable frequency drives (VFD's) will be supplied by other trades for motor driven equipment provided by them.

B. The electrical contractor shall install the starter/disconnects and VFD's, and shall provide all power wiring to the units and from the units to the motors they control.

2.7 CONTACTORS AND REMOTE CONTROL SWITCHES:

A. Provide mechanically held and electrically held contactors and remote control switches in manufacture and model as called out on the drawings.

2.8 CONDUCTORS:

A. Conductors shall be provided in Cerro Wire manufacture or comparable product in Southwire or Republic Wire.

B. All feeder conductors shall be copper, rated 600 volts 90 deg. C., dry and wet locations, type XHHW-2, color coded.

C. All branch lighting and power conductors shall be copper rated 600 volts, 90 deg. C., dry and wet locations, type XHHW-2, color coded. Branch lighting and power conductors shall be soft drawn copper with conductivity of not less than 98 percent of ANSI Standard for annealed copper.

D. Type 'MC' Cable:

1. Shall be a factory assembly of copper type THHN conductors including a green insulated equipment grounding conductor, with a mylar tape overall assembly covering, housed in a continuous interlocking galvanized steel sheath. Provide with optional insulated bushings.
2. Metal clad cable connectors shall be malleable iron set screw type connectors.

2.9 OUTLET, JUNCTION AND PULL BOXES:

A. Provide outlet boxes as required for a complete installation including, but not limited to the following: switches, receptacles, telephone/voice outlets, data outlets, video/CATV outlets, lighting fixtures, special lighting control outlets, fire detection system outlets, special systems outlets, audio/visual (A/V) outlets, CCTV camera outlets, security/access control outlets, etc.

B. For above ground pull boxes, provide galvanized code-gauge sheet steel units with screwed on covers, of size and shape required to accommodate wires without crowding, and to suit the location. Provide pull boxes as specified herein, as required for job conditions, and as follows:

1. Indoors: NEMA Type 1.
2. Outdoors or Damp or Wet Locations: NEMA Type 3R.
3. Hosedown and Splashing Water Locations: NEMA Type 4.

C. Provide polymer concrete in-ground pull boxes where indicated on the drawings. Polymer concrete pull boxes shall be Quazite boxes as manufactured by Hubbell or comparable product in Armorcast or Highline manufacture. Pull boxes shall be constructed of Polymer concrete

consisting of sand and aggregate bound together with a Polymer resin and reinforced by a heavy weave fiberglass. Pull box covers shall have a skid resistant finish and shall be secured with stainless steel bolts. Provide in-ground pull boxes of size and shape required to accommodate the service and suit the location.

H. Provide H-20 rated in-ground pre-cast concrete pull boxes with cast iron frame and cover where indicated on the drawings. Pre-cast boxes shall be provided with adequate provisions for drainage.

2.10 WIRING DEVICES:

A. All devices shall be furnished in Hubbell or comparable product in Cooper, Pass & Seymour, or Leviton. Devices specified herein are based on Hubbell unless otherwise noted. Receptacle and switch colors shall be as directed by the Architect and Owner.

B. Lighting Switches:

1. Toggle Type: Extra Heavy Duty industrial grade, flush mounting, quiet operation AC type with abuse resistant colored nylon toggle operator, heat resistant composition plastic housing, silver cadmium oxide contacts and copper alloy spring contact arm. Rated at 120-277 VAC, capable of full capacity on tungsten, fluorescent, or LED lamp load. Designed for side or back wiring with up to No. 10 wire, and with #8 brass terminal screws.

C. Receptacles:

1. Single and duplex convenience receptacles shall be extra heavy duty specification grade, 2 pole, 3 wire grounding, NEMA 5-20R, rated 20AMP at 125 Volts AC. Receptacles shall have a one-piece all brass wrap around mounting strap with integral ground contacts and ground tension retaining clips, tandem bypass contact, heat resistant thermoplastic rynite base, and high impact nylon face. Receptacles shall be back and side wired, shall have a back wired green ground terminal, automatic ground clip, and threaded brass square head center rivet assembly.

Single Receptacle #HBL5361
Duplex Receptacle #HBL5362WR

2. Ground Fault Duplex convenience receptacles shall be extra heavy duty specification grade, 2 pole, 3 wire grounding, NEMA 5-20R, rated 20AMP at 125 volts AC. Receptacles shall have a solid brass wrap around mounting strap with pre-tensioned ground contacts, tandem modified bypass contacts, all glass circuit board with conformal coating for superior moisture immunity, 7 noise filtering capacitors, heat resistant thermoplastic base and high impact nylon face. Receptacles shall be side wired and shall have a green ground terminal.

Duplex GFCI Receptacle #GFR5362SG

D. Wall Plates:

1. Wall plates for flush outlets shall be specification grade smooth metal stainless steel type 302/304, satin finish. Where multiple devices are ganged together they shall be mounted under a common wall plate. Provide switch and receptacle combination plates where

switches and receptacles are located together. Cover plates shall be furnished in same manufacturer as devices.

2. Weatherproof enclosures for outdoor GFCI receptacles shall be cast aluminum, single gang vertical Hubbell #WP26M or single gang horizontal Hubbell #WP26MH. Enclosures shall include gasket and mounting screws, shall have ¼" diameter padlock holes, and shall have large cord openings for use with cover closed.

I. Stand-Alone (Non-System) Occupancy Sensors:

1. Provide passive infrared (PIR) and dual technology passive infrared/ultrasonic occupancy sensors in Hubbell manufacture, or comparable product in Lutron or WattStopper. Wall switch occupancy sensor colors shall be as directed by the Architect.

a. Line voltage dual technology wall switch sensor: Hubbell #LHTMS1.
b. Line voltage dual technology dual circuit wall switch sensor: Hubbell #LHMTD2.
c. Line voltage fixture mount passive infrared high bay sensor: Hubbell #WSP-EM-UNV.
d. Line voltage fixture mount passive infrared low bay sensor: Hubbell #WSP-EM-UNV/WSP-L360-LM-WH.
e. Low voltage dual technology extended range ceiling mount sensor with isolated relay and photocell: Hubbell #OMNI-DT-2000-RP-QTI.
f. Low voltage dual technology extended range ceiling or wall mount sensor with isolated relay and photocell: Hubbell #LODTRP-QTI.

2. Power Packs:

a. Provide Hubbell #UVPP-QTI Power Packs where shown on the drawings for use with the low voltage occupancy sensors. Power Packs shall be plenum rated, shall have universal 100/277VAC input voltage with low voltage output for sensor power, and shall have a 20 amp relay for load switching.

2. Slave Packs:

a. Provide Hubbell #MPSA-QTI Slave Packs where shown on the drawings. Slave Packs shall be plenum rated, shall be powered by its companion Power Pack, and shall have a 20 amp relay for load switching.

2.11 FUSES:

A. Provide current limited, non-renewable fuses in Littelfuse manufacture or comparable product in Bussman or Gould. Fuses shall be UL class J up to 600 Amp and Class L over 600 Amp.

2.12 GROUND RODS:

A. Ground rods shall be hardened steel with a minimum 10 mil thick electrolytic copper covering (copper-clad) and shall conform to UL 467. Ground rods shall be ¾" dia. x 10' long. Provide ground rods in Blackburn manufacture or comparable product in Erico or Galvan manufacture.

2.14 EXOTHERMIC WELDS:

A. All grounding/bonding connections to ground rods and building steel shall be made with exothermic welds. Provide in Cadweld or comparable product in Thermoweld or JMV manufacture.

2.15 BACKBOARDS:

A. Comply with Section 06 10 00 “Rough Carpentry”.

B. Backboards shall be constructed of fire retardant plywood sheets, 4’ x 8’ x ¾”.

1. Paint backboards on all sides with two coats of light gray fire-retardant paint prior to mounting equipment.

2. Mount backboards on unistrut channel supports.

2.16 ACCESS PANELS:

A. Provide access panels for electrical equipment and wiring splices which are not readily accessible. This includes electrical equipment and wiring splices installed above hung ceilings which are not readily removable, within walls, inside chases, or inside dead cavity spaces.

B. Provide access panels according to requirements of Section 08 31 16 “Access Panels and Frames”.

2.17 OTHER MATERIALS:

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the contractor subject to the approval of the engineer.

B. Provide miscellaneous hardware and support accessories, including unistrut, channels, jack chain, support rods, nuts, bolts, screws, and other such items, with galvanized or cadmium plated finish, or other approved rust inhibiting coatings.

PART 3 - EXECUTION

3.1 GENERAL:

A. Unless specifically noted or shown otherwise, install all equipment and material specified herein or shown on drawings whether or not specifically itemized herein. PART 3 covers particular installation methods and requirements peculiar to certain items and classes of materials and equipment.

B. Data indicated on the drawings and in these specifications are as exact as could be secured, but their absolute accuracy is not warranted. The exact locations, distances, levels and other conditions will be governed by actual construction and the drawings and specifications should be used only for guidance in such regard.

3.2 INSTALLATION OF RACEWAYS AND FITTINGS:

A. Install wire and cable in approved raceways as specified and as approved by authorities having jurisdiction.

B. Run conduit and cable parallel to or at right angles with lines of the building, to present a neat appearance.

1. Make bends with standard conduit elbows or conduit bent to not less than the same radius.
2. Make bends free from dents and flattening.

C. Provide code sized conduit unless a larger size is shown on the drawings or specified herein. Minimum conduit size shall be ¾" diameter.

D. Do not install conduit runs exposed on the building exterior.

E. Install link-seal waterproof seals around all conduit penetrations through basement walls, floors, or foundation walls.

F. Where conduit is installed underground or is exposed to weather or wet areas make all joints watertight. Seal all site work open conduit ends containing conductors water tight. Cap all site work open conduit ends that do not contain conductors.

G. Provide necessary sleeves and chases where conduits and cables pass through floors, walls, ceilings, and roofs, and provide other necessary openings and spaces, all arranged for in proper time to prevent unnecessary cutting. Perform cutting and patching in accordance with the provisions for the original work.

H. Feeder, branch circuit, fire alarm, or special systems conduits shall not be run below concrete slabs or in concrete slabs unless specifically indicated so on the drawings, or unless there is no other way to feed the outlet, device, or equipment.

I. Lubricants or cleaning agents which might have deleterious effect on conductor coverings shall not be used for drawing conductors into raceways.

J. All wiring shall be installed in electrical metallic tubing unless otherwise specified herein or called for on the drawings.

1. Where conduit is installed underground (buried) in non-classified locations, provide PVC conduit.
2. Where conduit is installed underground (buried) or aboveground in classified locations, provide rigid steel conduit.
2. Where conduit is installed embedded in cinder concrete, provide rigid galvanized steel conduit.
3. Provide intermediate steel conduit for exposed conduit installed below 7 feet in mechanical rooms, or where subject to physical abuse.
4. Use flexible conduit for final connections to motor driven equipment, recessed light fixtures, chain hung light fixtures, transformers, or where subject to vibration. Where such equipment is located in wet areas or exposed to weather use liquid-tight flexible conduit. Flexible connections shall be minimum of 18 inches and maximum of 6 feet long with

grounding conductor. Flexible connections shall be used prior to attachment of conduit to equipment housing.

3.3 SLEEVES:

A. Provide EMT sleeves for each conduit and cable passing through walls, partitions, and floors.

1. Set pipe sleeves in place before wall, floor, or partition is finished.
2. Support conduit and cable free from sleeves.
3. Provide sleeves two pipe sizes larger than the conduit or cable passing through, or provide a minimum of ½" clearance.

3.4 CONDUCTOR INSTALLATION:

A. General:

1. The interior of all conduits shall be cleared of burrs, moisture, dirt and obstructions before wires are pulled.

2. Lubricant for pulling wires shall be inert to cable and conduit, shall not in any way restrict ease of pulling through conduit with passage of time, and shall be special lubricant designed specifically for cable pulling and shall be chemically compatible with cable.

3. Emergency circuit wiring shall be kept entirely independent of all other wiring in accordance with NEC Article 700.10(B).

B. Color Coding:

1. Consistent phase identification of all conductors shall be maintained as follows:

	120/208V	277/480V
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral Wire	White	Natural Gray

Provide colored plastic tape of specified color code identification for large size conductors available only in black. Wrap tape three complete turns around conductor, at ends and at connections and splices. Provide same color coding for switch legs as corresponding phase conductor.

C. Minimum Conductor Sizes:

1. The minimum branch circuit conductor size shall be #12AWG. Provide #10AWG conductors for branch circuits where the conductor run exceeds 75 feet, and #8AWG conductors where the conductor run exceeds 150 feet.

D. Provide the number of conductors required for a given branch circuit, or as required for circuitry, whether indicated on the drawings or not.

E. Neutral Conductors:

1. All branch circuits shall be installed with a separate neutral conductor. Shared neutrals for groups of branch circuits shall not be permitted.

F. Provide each circuit with a dedicated ground wire back to its respective panel ground bar. Size all ground wires in accordance with NEC requirements. Use #12AWG minimum size.

G. Identify conductors passing through pull boxes, junction boxes, and wireways to indicate circuit designation. Identify pull boxes and junction boxes as specified herein.

H. Branch circuit wiring and arrangement of home runs have been designed for maximum economy consistent with adequate sizing for voltage drops, circuit ampacities and other considerations.

1. Install the wiring with circuits arranged as shown on the drawings, except as otherwise approved in advance by the Architect and Engineer.

2. Do not make changes and rearrange circuits without prior approval.

3. If more than 3 current carrying conductors are installed in one conduit they shall be derated in accordance with the National Electric Code. Do not install more than three 30 Amp single phase or four 20 Amp single phase circuits in the same conduit. Do not run emergency and normal power wiring in the same conduit.

I. Splices and Connections:

1. Make splices electrically and mechanically secure with pressure-type connectors.

a. For wires size #8AWG and smaller, provide solderless, screw-on connectors, 600V rating, of size and type to manufacturer's recommendation, with temperature ratings equal to the conductor insulation.

b. Make splices and terminations to conductors #6AWG and larger with corrosion-resistant, high conductivity, pressure indent, hex screw or bolt clamp connectors, with or without tongues, designed specifically for intended service. Connectors for cables 250 kcmil and larger shall have two clamping elements or compression indents. Terminals for bus connections shall have two bolt holes. Splitbolt connectors, Burndy, Ilsco or Greaves, shall be acceptable for all splices of conductors #6AWG and larger.

2. Insulate splices with a minimum of two layers of all weather, heavy duty, abrasion resistant, 8.5 mil thick, 105 degree C. rated vinyl electrical tape where insulation is required. Tape splices 1 ½ times the thickness of the conductor insulation.

3. Provide high conductivity copper alloy bolt-on lugs with pressure plate and socket set screw or hex head screw to attach wire and cable to disconnect switches, transformers, and other electrical equipment as required.

3.5 OUTLET BOXES:

A. All outlet boxes in finished areas shall be concealed from view above hung ceilings or recessed (flush) in walls and floors. Outlet boxes may only be exposed to view or surface mount type for feeding items overhead in rooms without ceilings, in mechanical and electrical rooms, MDF and IDF Rooms, Welding Lab, Plumbing Lab, Electrical Lab, Masonry Lab, Auto Repair, and Autobody Repair.

B. Install outlet boxes at uniform heights and straight and true with reference to walls, floors, ceilings and casework.

C. Secure all outlet boxes to building structure with metal straps, rods, or bolts independently of entering conduits or cables.

D. Provide bar hanger outlets in hollow framed partitions with bar hanger secured to partition studs with self-threading screws, or drill through hangers with Caddy or equal clips.

E. Provide horizontal separation for outlet boxes mounted on opposite sides of common wall. Back to back or thru-wall boxes will not be permitted.

3.6 PULL BOXES AND JUNCTION BOXES:

A. Provide pull boxes and junction boxes where shown on the plans and where required to facilitate proper pulling of wires and cables. Install pull boxes no less than one every 100 ft. of straight horizontal conduit run, or three 90 degree bends, unless otherwise noted.

B. For site work provide pull boxes no less than one every 400 feet of straight run or two 90 degree bends, unless shown or noted differently.

3.7 WIRING DEVICES:

A. Wherever possible install switches directly adjacent to the strike side of door. Check architectural drawings for door swing.

B. Where receptacles and outlets are shown over counters, refer to architectural drawings for mounting heights.

C. Install receptacles vertically with grounding posts at top of device, except locate grounding post to left for horizontal mounting.

3.8 WIRING DEVICE PLATES:

A. Set plates so that all edges are in contact with mounting surface. Provide common device plate for multi-device locations.

3.9 MOTOR POWER AND CONTROL WIRING:

A. Contractor shall provide and be responsible for the complete power wiring of all motors and motorized equipment.

B. Furnish proper overload and short circuit protection for all new motors. Provide a combination thermal overload and disconnect switch for all equipment using fractional horsepower motors.

3.10 GROUNDING SYSTEM:

A. Provide a complete grounding system which will thoroughly ground the non-current carrying metal parts of every piece of installed equipment, as described herein and as indicated on the drawings.

B. System shall be mechanically and electrically connected to provide an independent return path to the grounding sources.

C. Each grounding conductor shall have a minimum capacity of 25 percent of the rated capacity of the equipment it grounds, unless otherwise indicated.

D. The minimum size of grounding conductors shall be No. 12 AWG copper. Insulation color of grounding conductors shall be green.

E. Provide a separate green ground conductor for each feeder and branch circuit.

G. Grounding of Motors: Motors shall be grounded by connecting a green covered conductor from a grounding bushing in the starter to the motor frame. Conductor shall be installed in the conduit with the circuit conductors and terminated in the motor connection box, providing the terminal is mechanically connected to the frame. If this is not feasible, grounding conductor from the starter shall be extended through an insulated bushed opening in the connection box and connected to motor base.

3.11 SPECIAL REQUIREMENTS:

A. Wiring shall be bundle tied where passing through pull boxes, wireways, and panelboards in neat and orderly manner with plastic cable ties. Cable ties shall be Ty-Raps as manufactured by Thomas & Betts, or comparable product in 3M or Leco Plastics manufacture.

B. Turn branch circuit and auxiliary system wiring out of wiring gutters at 90 degrees to circuit breakers and terminal lugs.

C. Provide miscellaneous hardware and support accessories, including channels, unistrut, jack chain, support rods, nuts, bolts, screws, and other such items, with galvanized or cadmium plated finish, or other approved rust inhibiting coatings.

3.12 TESTING AND INSPECTION:

A. Provide personnel and equipment, make required tests, and secure required approvals from the Architect and governmental agencies having jurisdiction.

B. When material and/or workmanship is found to not comply with the specified requirements, within three days after receipt of notice of such non-compliance remove the non-complying items from the job site and replace them with items complying with the specified requirements, all at no additional cost to the Owner.

C. Perform all required adjustments and settings. Verify and correct deficiencies as necessary including voltages, tap settings, trip settings and phasing of equipment from distribution system to point of use.

D. Provide all necessary testing equipment.

E. Main ground electrode system shall not exceed 10 ohms unless specified otherwise.

1. Verify ground resistance by ground continuity test between main ground system and equipment frame system neutral and/or derived neutral point.

2. Perform ground continuity test by passing minimum of ten Amps DC between ground reference system and ground point. Calculate resistance by voltage drop method.

F. Balance all panels as follows:

1. Turn on all lighting and equipment served by a panel and measure the current in each branch circuit phase and neutral conductor and in each phase and neutral bus-bar. Log all measurements taken and then correct imbalance by substituting branch circuits from phase to phase until optimum balance is achieved. Log all final current measurements and submit for the Engineer's review.

2. Also measure and log voltages between each phase bus-bar and between each phase bus-bar and neutral bus-bar and submit measurements for the Engineer's review.

3.13 PROJECT COMPLETION:

A. Upon completion of the work of this Section, thoroughly clean all exposed portions of the electrical installation, removing all traces of soil, labels, grease, oil and other foreign material, and using only the type cleaner recommended by the manufacturer of the item being cleaned.

B. Vacuum all exteriors and interiors of switchboards, panelboards, transfer switches, safety switches, and equipment racks to remove all dust, dirt, cable clippings, etc.

C. Equipment with damage to painted finish shall be repaired to satisfaction of the Architect.

END OF SECTION 26 05 00

ISSUED for BID

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including Division 0, Contract Requirements, and Division 1, General Requirements, are a part of this Section and shall be binding on the Contractor and /or Subcontractor who performs this work. Note also all addenda.

B. Section 26 00 00, General Electrical, shall also govern the work under this Section.

C. Section 26 05 00, Basic Electrical Materials & Methods, includes requirements that are binding on this Section.

D. Examine all drawings, data, and coordinate the work of this Section with all related and adjoining work.

1.2 SCOPE OF WORK:

A. Scope of work consists of installation of materials to be furnished under this Section, and without limiting generality thereof consists of furnishing labor, materials, equipment, hoisting, plant, transportation, rigging, staging, appurtenances, and services necessary and/or incidental to properly complete all electrical work as shown on the drawings, as described in these specifications or as reasonably inferred from either as being required in opinion of the Architect and Engineer.

B. Work Included: Provide complete electrical services where shown on the drawings, as specified herein and as needed for a complete and proper installation including but not necessarily limited to:

1. Short circuit/coordination study.
2. Panelboards.
3. Transformer.
4. Surge suppression equipment (SPD devices).
5. Lightning arrestor.
6. Starters.
7. Feeder Distribution.
8. Grounding.
9. Plywood mounting backboards.

1.3 QUALITY ASSURANCE:

A. Codes and Standards: Refer to Section 26 00 00.

1.4 SUBMITTALS:

A. Shop Drawings: Submit for all items listed in paragraph 1.2, B.

B. For panelboard manufacturers other than the basis of design manufacturer, the Contractor shall provide ¼" scale Autocad drawings of each Electrical Room showing proposed layout of panelboards and transformers along with relevant code clearances. The purpose of this requirement is to demonstrate that the proposed equipment will fit in the room allowing for code required working spaces.

C. Submit the short circuit/coordination study concurrently with the equipment submittals. Panelboard submittals will not be reviewed without the short circuit/coordination study.

PART 2 – PRODUCTS

2.1 SERVICE APPLICATION

A. The contractor shall contact the utility company and shall submit a Contractors Request for Service (CRS) application for the project. All information required for this application shall be obtained and provided by the contractor. The contractor shall review the proposed service with the Utility Company prior to starting work and shall comply with all Utility Company construction standards and any other requirements that may be peculiar to this project.

B. The Groton Utilities New Service Consultant for this project is Mike Fedors (fedorsm@yurservice.com), telephone #860-446-4024.

2.2 PRIMARY SERVICE

A. The underground primary conductors will be supplied and installed by Groton Utilities from existing utilities on site.

B. The Electrical Contractor shall furnish and install 2 - 5" PVC underground conduits, H-20 rated primary handholes, and other materials as required by Groton Utilities to install the underground primary line and tie-in the new pad mounted transformer.

2.3 PAD MOUNTED TRANSFORMER

A. The pad mount transformer will be furnished and installed by Groton Utilities.

B. The Electrical Contractor shall provide and install a pre-cast reinforced concrete pad for the transformer as manufactured by Rotondo & Sons, Inc. or comparable product in United Concrete Products, Inc. or Arrow Concrete Products. The size of the pad shall be 76" x 54" x 36" for the Field House per Groton Utilities Standards.

C. Provide a grounding grid for the transformer pad in accordance with Groton Utilities Standards.

2.4 SECONDARY ELECTRICAL SERVICES

A. The secondary electrical service for the Field House will be 200 amp, 3 phase, 4 wire, 480Y/277 volts.

B. Furnish and install secondary underground service consisting of quantity of conductors and conduits as indicated on the Power Riser Diagram.

C. Secondary service conduits shall be rigid PVC with rigid galvanized steel elbows.

2.5 GROUNDING

A. Furnish and install a grounding grid at the pad mount transformer as required by Groton Utilities.

B. Provide #3/0 AWG copper service ground cable in conduit and extend and connect to the domestic water service entrance pipe. If a water meter is present at this location, provide a conductor of the same type and size and bond to water pipe on both sides of the water meter. Provide #3/0 copper service ground cable and bond the water service entrance pipe to the natural gas service entrance pipe. Provide bronze ground clamps for grounding and bonding connections to the pipes.

C. Provide #3/0 copper service ground cable in conduit to concrete encased steel reinforcing bar located within or near the bottom of a concrete foundation or footing that is in direct contact with the earth. Reinforcing bar shall consist of at least 20 feet of one bar or the equivalent length in multiple bars bonded together by steel tie wires. Reinforcing bars shall be ½" diameter or larger. Provide an exothermic weld connection to the reinforcing bar(s).

D. Bond the transformer pad grounding grid to the grounding electrode system.

E. Refer to Section 26 05 00 for equipment, conduit, and panelboard grounding.

2.6 METHOD OF CONDUCTOR IDENTIFICATION:

A. Provide a typewritten adhesive label with an identification legend at each panelboard identifying the color coding of the ungrounded conductors being supplied by the panelboard.

2.7 PANELBOARDS:

A. Distribution, lighting, and power panels shall be furnished in Eaton manufacturer or comparable product in Square D or Siemens, AIC ratings as noted in the panel schedules.

B. Panelboards shall be equipped with the following features:

1. Bolt-on circuit breakers.
2. Symmetrical interiors.
3. Surface or flush trim as called for in schedule, door-in-door type.
4. Flush key catch lock.
5. Painted finish, ANSI-61 gray.
6. Metal frame/plastic cover index card holder.
7. Separate equipment ground bus.
8. Fast latch trim and jacking screw adjustment.
9. Split neutral.
10. Connection accessible from front.
11. 1000 amps per square inch density rated silver-plated copper busses.
12. Copper ground bar.

13. Black face/white core engraved nameplate fixed to panel w/ two screws or rivets.

D. Indexing and Identification: After installations are complete, provide and mount under sturdy transparent shield in the directory frame of each panel door a neat, accurate and carefully typed directory properly identifying the lighting, receptacles, outlets, equipment and rooms which each branch circuit breaker controls.

E. All circuit breakers feeding mechanical equipment shall be 'HACR' rated.

F. Circuit breakers 200 amps and larger shall be equipped with solid state trip units.

2.8 CIRCUIT BREAKERS:

A. Circuit breakers shall be bolt-on type with short circuit interrupting rating as indicated in panel schedule. Circuit breakers shall be fully rated.

B. Circuit breakers shall be provided with AL/Cu lugs (cable connectors).

C. Circuit breakers serving motorized equipment shall be 'HACR' rated.

D. 20 Amp, 1-Pole circuit breakers shall be listed by the Manufacturer for use with #12AWG through #10AWG conductor sizes.

E. Circuit breakers 200 amps and larger shall be equipped with solid state trip units.

2.9 DRY-TYPE TRANSFORMERS:

A. Provide Dry-Type transformers as shown and scheduled on the drawings. Transformers shall be furnished in the same manufacturer as the panelboards, or in Marcus (MTC) manufacturer.

B. Transformers shall be 480 Volts delta primary – 208Y/120 Volts secondary, three phase, 60Hz, of temperature rise, sound level, and KVA rating scheduled on the drawings. Transformers shall have copper windings.

C. Transformers shall have 6-2 ½% full capacity primary taps, 2 above normal primary voltage and 4 below normal primary voltage.

D. All transformers shall be NEMA TP-1 compliant and shall bear the Energy Star label.

E. Transformers shall have Class 220 insulation.

F. Transformer coil and core assemblies shall be mounted on rubber isolation pads to minimize sound transmission.

G. Transformer enclosures shall be heavy gauge sheet steel, ventilated, floor or wall mount. Enclosure finish shall be an indoor/outdoor electrostatically applied polyester coating.

H. Transformer sound levels shall be guaranteed by the manufacturer not to exceed 45DB for 15KVA through 50KVA, 50DB for 51KVA through 150 KVA, and 55DB for 151 KVA through 300 KVA.

I. Transformers shall be mounted on spring isolation bases.

J. Transformers shall be provided with AL/CU line (primary) and load (secondary) lugs.

2.10 MOTOR STARTERS AND VFD'S:

A. Motor starters and variable frequency drives (VFD'S) shall be furnished by each respective trade for motor driven equipment provided by them. The Electrical Contractor shall install the starters and VFD'S, and shall provide all power wiring to the starters and VFD'S, and from the starters and VFD'S to the motors they control.

B. Motor starters and VFD'S shall conform to requirements of NEC, NEMA, UL, CSA, and ANSI and shall be suitable for the required horsepower, duty, voltage, phase, frequency, service, and location. All starters and VFD'S shall be furnished in NEMA enclosures suitable for the environment in which they are to be located.

C. All starters shall be of the same manufacture and shall be furnished in Cutler-Hammer, Siemens, Square D, or Allen Bradley.

D. Thermal Overloads:

1. All motors 1/8 horsepower or larger shall be provided with thermal-overload protection. Thermal overloads shall be melting alloy ambient temperature compensating type.
2. Thermal overloads shall be sized in accordance with NEC requirements for the nameplate data of the motor(s) as actually delivered to the site.

E. Starters for manual control of single phase motors up to one (1) horsepower furnished without integral thermal overloads shall be combination manual disconnect switch and starters with thermal overload protection for each ungrounded leg. Starters shall be inoperable if a thermal unit is removed. These starters shall be 2-pole and shall be provided with green neon pilot light and handle guard/lock-off.

F. Starters for three phase motors shall be full voltage, circuit breaker combination magnetic starters. All circuit breaker combination magnetic starters shall include melting alloy type thermal overload protection, low voltage protection, and two (2) sets of auxiliary normally open and normally closed contacts. Thermal overload protection shall be provided in each ungrounded leg. Starters shall be inoperable if a thermal unit is removed. All circuit breaker combination magnetic starters shall be equipped with control power circuits. Provide starters with control power transformers of secondary voltage required for the control power circuitry. Provide control power transformers with primary and secondary fusing. The disconnect handle on circuit breaker combination magnetic starters shall always be in control of the disconnect device with the door opened or closed. The disconnect handle shall be clearly marked as to whether the disconnect device is "on" or "off", and shall include a two-color handle grip, the black side visible in the "off" position, and the red side visible in the "on" position.

1. All circuit breaker combination magnetic starters for manual control of three phase motors shall have start-stop push buttons in the cover and shall be provided with red and green pilot lights.

2. All circuit breaker combination magnetic starters for automatic or interlocking control of three phase motors shall have hand-off-automatic selector switches in the cover and shall be provided with red and green pilot lights.

2.11 BACKBOARDS:

A. Comply with Section 06 10 00 “Rough Carpentry”.

B. Backboards shall be constructed of fire retardant plywood sheets 4’ x 8’ x 3/4”.

1. Paint backboards on all sides with two coats of light gray fire retardant paint prior to mounting equipment.
2. Mount backboards on unistrut channel supports.

C. Provide backboards for mounting all surface mounted electrical panels, disconnect switches, transfer switches, VFD’S, and motor starters.

PART 3 - EXECUTION

3.1 INSTALLATION OF CONDUITS:

A. The contractor, before proceeding with installation of underground conduits, shall see to that all trenching and excavation is free of rock and that trenching is prepared in accordance with applicable sections of these specifications.

B. Conduit runs overhead in building shall be run in a neat and orderly manner, parallel with and at right angles to walls. Conduits shall be racked and properly supported.

C. The contractor shall coordinate the location of all conduit runs with other trades before proceeding with installation.

3.2 PANELBOARDS:

A. Mount panels 4'-0" to panel center but with maximum height of 6'-7" to handle of topmost switching device when in its highest position.

B. Provide double locknuts and insulated throat grounding bushings on each feeder conduit entering panel, switchboard, transformer, disconnect switch, pull box, or wireway. Run No. 4 stranded bare copper ground wire through each grounding lug and connect to enclosure grounding lug.

C. For each flush mounted panel install two (2) spare 1 1/2" conduits from panel box to point above finished accessible ceiling for future use.

3.3 START-UP, TESTING, AND TRAINING

A. The contractor shall engage the equipment manufacturer’s service group to perform manufacturers recommended start-up procedures for the switchboard, panelboards, and transformers including checking cable connector/lug torques, ground fault testing, insulation resistance testing and field adjustments of the protective devices as required for placing the equipment in final operating

condition. The equipment manufacturer's service group shall also perform a primary injection test on the building main circuit breaker. The primary injection test shall be performed in accordance with NETA specifications.

B. The equipment manufacturer's service group shall perform a thermal scan of all breaker to cable connections, breaker to bus connections, and cable to panel chassis connections. Scope is to include main transformer connections, and all transformers, and panelboards. Tests are to be done with the building normally loaded for a minimum of 2 hours, not with partial or unloaded condition.

Thermal scans temperatures shall be evaluated as follows (based on comparable size or adjacent phases and loaded breakers, bus connections, and terminations)

1. 1-3 degrees C rise, Investigate as to the cause of temp rise.
2. 4 – 15 degree C rise, Repair as soon as possible.
3. 16 or higher degree C rise, Repair immediately.

C. The contractor shall retain the equipment manufacturer's factory service group to provide two (2) separate 4-hour training sessions for the Owners personnel. The training sessions will be conducted at times designated by the Owner.

END OF SECTION 26 20 00

ISSUED for BID

SECTION 26 41 00 - LIGHTNING PROTECTION

PART 1 - GENERAL

1.1 SCOPE

A. Furnish and install a Class I lightning protection system for each building (3) as specified herein.

B. The work covered by this section of the specifications consists of furnishing all labor, materials and items of service required for the completion of a functional and unobtrusive lightning protection system approved by the architect and engineer, and in strict accordance with this section and applicable contract drawings.

C. If any departure from the specifications is deemed necessary by the contractor, details and reasons of such departures shall be submitted as soon as practical to the architect and engineer for approval.

D. The lightning protection system shall be designed by a Lightning Protection Certified Master Designer and the design drawings shall bear the designers seal. The seal shall be current at the time of submission and shall be signed by the Master Designer.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Grounding: Sections 26 05 00 and 26 20 00.

B. Architecturally – Exposed Structural Steel Framing: Section 05 12 13.

C. Polyvinyl Chloride (PVC) Roofing: Section 07 54 19.

D. Sheet Metal Roofing: Section 07 61 00.

E. Sheet Metal Flashing and Trim: Section 07 62 00.

F. Manufactured Roof Specialties: Section 07 71 00.

G. Metal Framed Skylights: Section 08 63 13.

H. Louvers and Vents: Section 08 90 00.

I. Boxed Louvered Penthouses: Section 23 31 15.

J. Metal Ducts: Section 23 31 13.

1.3 QUALITY ASSURANCE

A. The latest issue of the following standards forms a part of this specification:

1. Installation Requirements for Lightning Protection Systems, UL 96A.

2. Lightning Protection Components, UL 96.

B. The lightning protection system shall conform to the requirements and standards for lightning protection systems of UL and NFPA. Upon completion of the installation, the lightning protection system contractor shall make application to Underwriters Laboratories, Inc. for inspection of the system and issuance of the UL Master Label.

C. Acceptable manufacturers shall be regularly engaged in production of lightning protection equipment that has been installed, inspected, and certified for UL Master Labels. Acceptable manufacturers are as follows:

1. Northeast Lightning Protection - Bloomfield, CT.
2. Smokestack Lightning Protection – Brookfield, MA.
3. Advanced Lightning Protection and Construction, Inc. – Hanson MA..

D. Erector Qualifications: At least 5 years experience in installing systems which have been certified for UL Master Labels.

1.4 SUBMITTALS

A. Submit the following to the architect and engineer for review:

1. Complete design drawings in AutoCAD format on 1/8” = 1’-0” scale plans showing the type, size, and locations of all grounding conductors, grounding connections, down conductors, through roof/through wall assemblies, roof conductors, and air terminals.
2. Bill of material listing manufacturer and catalog numbers of equipment.
3. Catalog cuts of equipment.
4. Descriptive data covering equipment.
5. Manufacturer's installation instructions in accordance with UL 96A.

B. Label: Underwriter's Laboratories, Inc. Master Label for each installed system.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials with Underwriter's Laboratory's and manufacturer's labels intact and legible.

B. Store materials so they are not in contact with the ground.

C. Store packaged materials in original unopened package or container.

D. Protect materials from damage and corrosion until used.

E. Keep UL labels affixed.

F. Remove broken or damage material from project site.

PART 2 - PRODUCTS

2.1 GENERAL

A. The systems to be furnished under this specification shall be the standard product of a manufacturer regularly engaged in the production of lightning protection equipment and shall be the manufacturers latest approved design. The equipment shall be UL listed and properly UL labeled. All equipment shall be new, and of design and construction to suit the application where it is used in accordance with accepted industry standards and UL and NFPA requirements.

B. Provide and install complete lightning protection systems in compliance with these specifications and the most current editions of NFPA-780 and UL 96A. Each system shall be installed by a lightning protection contractor who is listed by Underwriters Laboratories, Inc.

2.2 MATERIALS

A. All lightning protection materials and components shall comply in weight, size, and composition with UL 96 and NFPA-780 lightning protection material requirements for each type of structure. All materials shall be copper, bronze, or stainless steel. Aluminum components shall be used in locations where system components are mounted to aluminum surfaces to avoid galvanic corrosion of dissimilar metals. All materials shall be Class 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The installations shall be accomplished by an experienced installation company that is listed with Underwriters Laboratories, Inc. for lightning protection installation. The installation company shall utilize Lightning Protection Institute Certified Master Installers. All equipment shall be installed in a neat and workmanlike manner. Each system shall consist of a complete conductor network at the roof and shall include air terminals, connectors, splices, bonds, down leads, and proper ground terminals.

B. Each installation shall be made in an inconspicuous manner. Conductors shall be coursed within 2 feet of outer edge of flat roof areas. Down conductors shall be concealed within the walls of the building. Provide sleeves through roof, floor slabs and all building construction. Where conductors or air terminals pass through the roof, they shall be properly flashed to conform with the roofing requirements.

All cable to cable connections shall be made by using approved U.L. clamps. Fasteners shall be spaced not more than 3 feet apart. All connections and splices shall withstand a pull test of 200 pounds.

C. All underground sizable metallic objects within 6 feet of the lightning protection systems or metal connected to the system, shall be bonded to the system. Install common grounds between the lightning protection system, electric service ground, telephone service ground, CATV service ground, and underground metallic piping systems.

D. Provide materials and items of service required for completion of functional and unobtrusive systems. Install conductors and complimentary parts in concealed system so completed work does not detract from appearance of the structures.

E. The lightning protection installer shall work with other trades to ensure a correct, neat, and unobtrusive installation. The roofing contractor shall be responsible for sealing and flashing all lightning protection roof penetrations in accordance with the roof manufacturer's recommendations.

3.2 CERTIFICATION

A. Upon completion of each installation, the contractor shall furnish the Master Label issued by Underwriters Laboratories, Inc. for each system to the Owner.

END OF SECTION 26 41 00

PART I - GENERAL

1.1 RELATED DOCUMENTS:

A. The General Provisions of the Contract, including Division 0, Contract Requirements, and Division 1, General Requirements, are a part of this Section and shall be binding on the Contractor and /or Subcontractor who performs this work. Note also all addenda.

B. Section 26 00 00, General Electrical, shall also govern the work under this Section.

C. Section 26 05 00, Basic Electrical Materials & Methods, includes requirements that are binding on this Section.

D. Examine all drawings, data, and coordinate the work of this Section with all related and adjoining work.

E. Section 01 78 30 “Warranties and Bonds – CMR” for additional warranty requirements applicable to this Section.

1.2 SCOPE OF WORK:

A. Scope of work consists of installation of materials to be furnished under these Specifications and without limiting generality thereof consists of furnishing labor, materials, equipment, hoisting, plant, transportation, rigging, staging, appurtenances, and services necessary and/or incidental to properly complete all electrical work as shown on drawings, as described in the Specifications or as reasonably inferred from either as being required in opinion of the Architect and Engineer.

B. Work Included: Provide complete electrical services where shown on the drawings, as specified herein and as needed for a complete and proper installation including but not necessarily limited to:

1. Lighting Fixtures
2. Site Lighting Standards
3. Precast Concrete Bases for Site Lighting Standards.

1.3 QUALITY ASSURANCE:

A. Refer to Section 26 00 00.

B. All lighting fixtures shall be U.L. labeled.

1.4 WARRANTY:

A. LED Fixture Warranties: Warrant complete LED systems, including LED’s, drivers, and all

other system components as specified in Section 01 78 30 "Warranties and Bonds – CMR", against failure, variation in color temperature beyond plus/minus 200 degrees Kelvin, and depreciation of output below 70%.

1.5 SUBMITTALS:

A. Shop Drawings: Submit for all items listed in Paragraph 1.2.B.

B. Submit manufacturers catalog cuts, specifications, and lighting distribution curve for each fixture.

C. Provide fully operating samples of light fixtures for review when requested by the Engineer.

PART 2 - PRODUCTS

2.1 LAMPS:

A. Solid State Lighting/Light Emitting Diodes (LED's)

1. All individual LED's used within a luminaire must be manufactured by a reputable LED manufacturer such as Cree, Osram Sylvania, Nichia, Philips, or comparable product. LED modules shall be manufactured by Bridgelux, Philips (Fortimo), Xicato, or Cree.
2. Testing: All products shall be tested by a Nationally Recognized Testing Laboratory (NRTL) in accordance with IES LM-79 testing methods and shall carry a UL, ETL, or CSA label. Fixture manufacturer shall confirm in writing that the LED's within the fixture will not exceed the maximum temperature to which the LED die was tested using IES LM-80 testing methods.
3. Drive Current, Thermal Management, and LED Rated Life: Drivers must not overdrive the LED's beyond the LED manufacturer's recommendations and shall adhere to device manufacturer's recommendations, certification programs, and test procedures for thermal management of LED's within their fixtures. Drive current and luminaire thermal design must ensure minimum 50,000 hour rated life for the LED's.
4. Color Consistency: All LED's from the same manufacturer, both within each luminaire and from luminaire to luminaire, must be batch sorted for visual color and brightness consistency. All luminaires of the same type shall be supplied at the same time and shall come from the same batch. Spare luminaires, when required, shall be provided from the same batch.
5. Dimming: Luminaire manufacturer must provide specific data on the means of dimming for coordination of the proper control device (specified elsewhere). Acceptable methods include electronic low voltage dimming and 0-10V 4-wire dimming protocol. Dimming must provide uniform, smooth, flicker free, full range dimming. LED's must maintain consistent brightness and color throughout the dimming range.
6. Maintenance: Luminaires must be designed, except where noted differently, so that the LED components may be removed from the fixture housing and replaced if required due to component failure.
7. Technology Upgrades: Supply the newest LED technologies that are available for the specified products when the orders are released, as long as there are no increases in input watts or cost.

2.2 LED DRIVERS:

A. Provide line voltage LED product, where available, to eliminate the need for drivers. If the LED product is not available as line voltage, then the LED drivers shall meet the following requirements:

1. Drivers shall have a minimum efficiency of 85%.
2. Starting Temperature: -40 degrees Celsius.
3. Input Voltage: capable of 120 to 277 volts (+/-10%), or as required by the site.
4. Power supplies can be Class 1 or Class 2 output.
5. Surge Protection: The system must survive 250 repetitive strikes of "C Low" (6kV/1.2 x 50ms, 10kA/8 x 20ms) waveforms at 1 minute intervals with less t6han 10% degradation in clamping voltage. "C Low" waveforms are as defined in IEEE/ANSI C62.41.2-2002, Scenario 1 Location Category C.
6. Drivers shall have a Power Factor (PF) equal to or greater than 0.90.
7. Drivers shall have a Total Harmonic Distortion (THD) equal to or less than 20%.
8. Drivers shall comply with FCC 47 cfr part 18 non-consumer RFI/EMI standards.
9. Drivers shall be Reduction of Hazardous Substances (RoHS) compliant.
10. Drivers external to luminaires shall be plenum rated for use in environmental air plenums.

2.3 ACCEPTABLE LIST OF LIGHTING FIXTURE MANUFACTURERS:

A. The light fixture schedule on the drawings is intended to indicate style, quality and performance for each fixture type listed. For each light fixture type, provide the basis of design fixture, comparable product #1, or comparable product #2 as scheduled in the Light Fixture Schedule on the drawings.

B. Lighting fixture submittals shall include dimensioned diagrams, photometric data, photographs or illustration of fixture, and written specifications for each fixture type. Submittals shall include point-by-point calculations for certain areas as specified herein and where required by the Engineer. Incomplete submittals will not be reviewed by the Engineer. At the engineer's request, the contractor shall provide table top samples of comparable product fixtures for comparison to the basis of design fixture. Failure to provide samples in a timely manner shall result in rejection of the submittal.

2.4 LIGHT FIXTURE SCHEDULE:

A. Refer to the Drawings.

B. Provide frame kits as required for fixtures recessed in sheet rock ceilings. Frame kits have not been scheduled on the drawings, but are to be provided by the Contractor as required for the installation. Refer to the architectural reflected ceiling plans for ceiling types.

2.5 EXIT SIGNS:

A. Units shall be LED light source, single or double face capability.

B. Units shall be suitable for top, end, or wall mounting.

C. Directional indicators (arrows) shall be provided where scheduled or indicated on the drawings, and shall be identifiable from a distance of 100'. Size and location of directional indicators (arrows) shall be in accordance with the Connecticut Fire Safety Code.

PART 3 - EXECUTION

1.1 INSTALLATION:

A. Each fixture shall be furnished with all necessary trims, brackets, fittings, and any other required accessories to properly install fixture.

B. Interior fixtures, exterior fixtures, and site lighting standards shall be installed plumb.

C. Lay-in grid type fixtures shall be securely fastened to the framing members of the grid system in accordance with N.E.C. Article 410.

1. Fixtures shall be independently supported from the building structure at all four corners with safety wire supports. Use minimum 16 gauge galvanized steel wire.

D. Suspended fixtures shall be hung from unistrut supports which shall be secured to structural steel.

E. Refer to the Architectural Reflected Ceiling Plans for final location of all ceiling mounted light fixtures.

END OF SECTION 26 50 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The General Provisions of the Contract, including General and Supplementary Conditions and Division 1, General Requirements, apply to the work specified in this Section.

B. Section 260000, General Electrical, shall also govern the work under this Section.

C. Section 260500, Basic Electrical Materials & Methods, includes requirements that are binding on this Section.

D. Examine all drawings, data, and coordinate the work of this Section with all related and adjoining work.

1.2 WORK INCLUDED

A. This section includes electrical & field lighting systems as specified herein.

1.3 REFERENCES

A. IES RP-6-2015, Current Recommended Practice for Sports Lighting, current edition

1.4 DEFINITIONS

A. Coefficient of variance (CV): A measure of uniformity. The formula for calculating CV values is given in IES RP-6, section 2.2.2 (page 3).

B. Uniformity gradient (UG): A measure of uniformity. UG is a measure of the rate of change of illuminance expressed as a ratio between the illuminance level of adjacent measuring points on a uniform grid

C. Primary playing area: An area including the playing field and extending 15 feet beyond the boundaries of the playing field in all directions.

1.5 SUBMITTALS

A. The submittal package shall include product data on the following:
Controls
Luminaires
Pole assemblies
Engineered foundation
Waveform Corrector
Wireless Control System

B. The submittal shall include the following shop drawings before construction:

1. The supplier shall supply drawings for each pole foundation. Drawings shall be sealed and signed by a professional engineer licensed in the **State of Connecticut**. Drawings shall include depth, diameter, and reinforcement.

2. The manufacturer shall submit a computer derived lighting plan showing the point-by-point horizontal maintained illuminance levels. The design is based on a maintained average illuminance level of 50 footcandles.

3. The manufacturer shall submit a computer derived lighting plan showing the point-by-point horizontal initial illuminance levels.

4. The two above shop drawings shall indicate illuminance levels on a 30 foot by 30 foot square grid. The grid shall be oriented such that one of the calculation points is offset fifteen feet in each direction from a point at the midpoint of the playing field.

5. In addition to the point-by-point illuminance levels, each of the two above shop drawings shall indicate the following:
   The maximum to minimum ratio of the primary playing area.
   The coefficient of variance of the primary playing area.
   The greatest uniformity gradient in the primary playing area.
   The mounting height to the lowest row of the luminaires.
   The number of luminaires used at each pole or location.
   The kilowatt consumption of the lighting system.
   The lamp lumens used in the calculations.

6. Light aiming point plan: The contractor shall submit an aiming plan indicating the horizontal degree setting and the vertical degree setting of each fixture on each of the pole assemblies.

7. A drawing or cut sheet of the luminaire assembly and its interface with the required poles.

1.7 QUALITY ASSURANCE

A. Bidders who do not currently possess the necessary qualifications, trained and experienced personnel, financial capacity, and meet the other requirements herein described will be disqualified.

B. The contractor that installs the sports lighting system shall have been in business at least five consecutive years under the same name and shall have installed, under that name, at least ten sports lighting systems similar to this project.

C. The contractor shall be fully experienced in the installation of the lighting systems as herein specified, and shall furnish with the bid an itemized list of the installations of this type. The list shall include the name of the project, date of completion, the amount of the contract, the name, and telephone number of the person to contact for reference.

D. The Sports Lighting Supplier shall be dedicated to sports lighting with in-house engineering, sales and support personnel. Supplier shall maintain inventory and personnel who are qualified to supervise the installation, to be responsible that the system is installed as submitted, to conduct system start up, instruct the Owners representatives in the proper operation of the system and provide service throughout the warranty period.

E. The Owner may make such investigations as he deems necessary to determine the ability of the

bidder to perform the work, and the bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder fails to satisfy the Owner that such bidder is properly qualified to carry out the obligations of the contract and to complete the work contemplated therein. Conditional bids will not be accepted.

F. Before using the bid of a subcontractor as part of his bid, the General Contractor shall satisfy himself that the proposed subcontractor can satisfy all of the requirements expressed above. The Owner reserves the right to reject any bid if the evidence submitted by, or investigation of, such bidder fails to satisfy the Owner that the bidder and/or any subcontractor he proposes can properly qualify to carry out the obligation of any part of the contract, and to complete the work contemplated therein.

G. The ability of any bidder to obtain plans and provide a performance bond shall not be regarded as the sole qualification of such bidder's competency and responsibility to meet the requirements and obligations of the contract.

H. Any bidder who bids products that do not meet specifications will be rejected. If bidder desires to propose alternate products, they must be submitted(per submittal section of bid specifications) for approval a minimum of 10 days prior to bid. Acceptable alternates will be approved by written addendum a minimum of 5 days prior to bid date.

I. All materials furnished under this Contract shall be new, free from defects of any kind, of the quality and design hereinafter specified, and shall conform to the standards of Underwriter's Laboratories Inc., except for equipment which U.L. does not list or provide label service.

1.8 WARRANTY

A. Light System Maintenance Free Warranty:
   1. Lighting Manufacturer must repair or replace any part of the sports lighting fixture or wiring that proves to be defective for a period of 10 years. Warranty must cover the cost for both labor and material. Warranty also guarantees light levels, aiming and energy consumption. Energy consumption will not increase as the system ages.

B. Structural Warranty:
   1. Lighting Manufacturer must repair or replace any structural component that proves to be defective for a period of 10 years. Warranty must cover both parts and labor.

C. Manufacturer’s Warranty:
   1. Lighting Manufacturer must maintain specifically funded financial reserves to assure fulfillment of the warranty for the full term. Warranty excludes fuses, storm damage, vandalism, abuse and unauthorized repairs or alterations

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Pole Foundations:

   1. The pole foundations shall be designed for allowable stresses in accordance with latest AASHTO standards. Foundation must be designed by a Structural Engineer Licensed in the State of Connecticut. Installation based on wind speed criteria indicated on the drawings.

B. Sports Lighting Poles:

1. The sports lighting pole system shall consist of galvanized steel poles with a factory pre-wired crossarm assembly. All wiring/connections should be factory assembled from the fixture mounting location to the base of the pole. Strain relief device(s) must be factory installed in pre-wired crossarm assembly to ensure no weight or tension is placed on electrical connections.

2. The sports lighting pole structure shall consist of a modular pole assembly. This shall consist of no more than two shaft components.

3. The entire sports lighting system (pole structure, wiring and fixtures) must be supplied by a single Company who underwrites warranty. Combining components of various Manufacturers is not acceptable.

4. The pole shafts cross-section shall be round. The pole shaft sections shall be high-strength steel meeting the requirements of ASTM A572 GR65.

5. Pole shaft sections shall be hot dip galvanized in accordance with the requirements of ASTM A123 specifications. Each shaft assembly must be completely coated, inside and out, in a single dip. Double dipping will not be permitted in compliance to USGA (United States Galvanizing Association) recommended practices and procedures to prevent acid entrapment.

6. All crossarms shall be factory pre-wired and assembled. The sports lighting pole system shall consist of concrete encased galvanized steel poles with a factory pre-wired crossarm assembly. All wiring/connections should be factory assembled from the fixture mounting location to the base of the pole. No field connections, plugs or Brad-Harrison type connectors are allowed. Strain relief device(s) must be factory installed in pre-wired crossarm assembly to ensure no weight or tension is placed on electrical connections.

7. All factory pre-wiring must be done in a manner that requires no electrical connections inside the pole or crossarm assembly to be made in the field. Sports lighting supplier must provide warranty as outlined in these specifications.

C. LED Luminaire Requirements:

1. LED Luminaire must be an integral unit with maximum distance of 18 inches between power supply, driver and LED's to minimize power loss and EMI (electromagnetic interference). Entire fixture must be factory assembled and vacuum sealed.

2. Luminaire must be UL Certified for wet locations at an operating temperature range rating between -40°C and +65°C.

3. Luminaire must be 3rd party NEMA 4X certified based on NEMA 250 standards for external icing, hose-down, and 200-hours salt spray test.

4. Luminaire must be 3rd party tested and certified to UL 844 vibration requirements.

5. Luminaire must be 3rd party tested and certified to ANSI C136.31, 3G vibration requirements.

6. Luminaire must be IP66 certified tested to IEC 60598-1 standards to meet dust-tight and powerful water jet-proof test.

7. Luminaire shall have a Correlated Color Temperature (CCT) of 5600K with a tolerance of ±300K, and a CRI of >68.

8. Luminaire shall be third-party verified to be flicker free at super slow motion speeds up to 2400 FPS and use pulse width modulation greater than 18 Khz with a flicker index rating <.06.

9. Luminaire shall have lumen depreciation, L70 rating, greater than 100,000 hrs certified through CREE Tempo-24 Testing or equivalent.

10. Luminaire shall include an integrated and thermal isolated power supply with wide input range 240VAC-480VAC**,** remote power supply's or drivers shall be located within 24" of the LED board to eliminate Electromagnetic interference and higher Total Harmonic Distortion which will generate heat on power lines and components connected to the distribution system and cause premature failures of those components.

11. Integrated power supply shall have the following features:

    a. Efficiency - Greater than 95% from 240VAC to 480VAC with full load applied

    b. Hold Up Time – Greater than 25msec

    c. Restrike Time - Less than 3.0sec to meet UL924 Emergency Lighting requirements

    d. Thermal Sensors – Monitor temperature readings of critical components, and self-protect when conditions exceeded, and report conditions wirelessly to remote site

    e. Ultra Low Standby Power – Less than 0.20% Standby power consumed with primary output disabled

    f. In-field Upgradable – remote wireless interface to program and update firmware/software.

12. Luminaire must have a fully integrated health telemetry capability.

13. Luminaire shall weigh less than 50lbs, including power supply, shade, bracket, and RF system.

14. Luminaire shall have an EPA of 1.4 square feet or less.

15. Luminaire shall have a power factor greater than 0.98 @ 277VAC and 0.97 @480VAC.

16. Luminaire shall have a THD (Total Harmonic Distortion) Less than 10% at 240VAC with full load and less than 14% at 480VAC at full load.

17. Luminaire must have an integrated pressure and humidity sensor.

18. Luminaire must have an integrated accelerator for aiming, commissioning, and feedback on light positioning.

19. Luminaire shall include custom lensing injection molded from optical grade, impact resistant lens with a UV additive to provide more than 25 years of long-term sunlight exposure.

18. Luminaire lensing shall be TIR (Total Internal Reflection) based.

19. Luminaire shall be constructed as a single pressure cavity vessel system. Enclosure shall include a breathable vent for pressure fluctuation reduction and increased seal life.

20. Aluminum shall be chromate conversion coated and then two-stage architectural grade powder coated for long term resistance to corrosion and UV exposure.

21. Luminaire shall include separate control cards to current balance each LED array into no less than 5 strings for effective lifetime management

D. Wireless Control System

1. Wireless control system shall provide local control and monitoring of the LED fixtures via a secure, self-forming, self-healing mesh network.

2. Wireless control system shall be utilized to switch lights on/off as well as dimming the system to specified levels with the Wireless control Hub.

3. Wireless control system shall have the capability to link to external devices such as smartphones and tablets as well as desktop and laptop systems via Bluetooth, wifi, LAN or cellular connection.

4. System shall be FCC/IC certified.

5. System shall be capable of storing power data, behaviors, alarms and critical events locally for maintenance and troubleshooting.

PART 3 EXECUTION

3.1 DELIVERY

A. The entire sports lighting system shall be delivered to the jobsite by the sports lighting supplier. All material (poles, fixtures, crossarm assemblies, etc) shall arrive the same day. The supplier shall off-load all material and stage required material at each pole location to eliminate possibility of lost or damaged material.

3.2 ERECTION

A. The erection of the poles shall be in accordance with the manufacturer's instructions.

B. The installation of the light fixtures shall be in accordance with the manufacturer's instructions.

3.3 CONSTRUCTION

A. Interface with Other Work:

1. Grounding: Each pole shall be grounded. The ground resistance shall be no less than 2.5 ohms. Ground terminals shall be located not less than 2 feet from the pole.

3.4 FIELD QUALITY CONTROL

A. Site Tests:

1. Testing for acceptance shall be by the Sports Lighting Supplier.

2. Test methods, instruments, and test intervals shall meet the approval of the Owners representative prior to testing.

3. Testing Equipment: Testing equipment for measurement of footcandle levels shall be performed using a Konica Minolta T-10 Illuminance Meter. Supplier must show proof of calibration prior to testing as required by the manufacturer. Accuracy shall be ± 4% or less of recording. Measuring functions shall be in footcandles.

4. Readings shall be recorded for each point and the results confirmed by Owner and/or Engineer.

5. Horizontal illuminance readings shall be taken in accordance with "IES Standard for Photometric Measurement of Area and Sports Lighting Installations".

6. Measurements shall be taken at 36" inches above grade, with meter held horizontally. Dark clothing shall be worn by individuals performing test.

7. The contractor shall take voltage and current readings at each pole base during the time of the test for the purpose of ascertaining the approximate fixture operating condition. Voltage at the pole base shall be adjusted within ± 5% of rated ballast voltage.

8. The contractor shall provide stakes or other identifiable markings at all test points on the field at the time of the test.

9. The measured values shall be within plus or minus ten percent of the calculated values indicated on the computer derived lighting plan of the initial illuminance levels.

10. Failure to meet criteria shall require that the fixtures be re-aimed and retested and added to until satisfactory results are obtained. Any expense of re-aiming, subsequent retesting additional fixtures and installation, if any, shall be borne by the supplier with no

additional cost to the Owner, Architect or Engineer.

3.5 ADJUSTING

A. Apparent "hot spots" or "dark spots" shall be eliminated by further fixture adjustment as required.

B. If in the judgment of the Owner's Representative, the manufacturers computed results cannot be obtained, this contractor shall furnish and install additional fixtures, wire, conduit, breakers, etc., as required to achieve the manufacturers predicted results at no additional cost to the Owner, Architect or Engineer.

END OF SECTION 26 56 19

PART 1.0 - GENERAL

1.1 RELATED DOCUMENTS

A. The Bidding Requirements, Contract Forms and Conditions of the Contract, including General and Supplementary Conditions, and Division 1 - General Requirements, apply to the work specified in this Section.

B. Section 26 00 00 – General Electrical, shall also govern the work under this Section.

C. Section 26 05 00, Basic Electrical Materials and Methods, includes requirements that are binding on this Section.

D. Examine all drawings, specifications, and data, and coordinate the work of this Section with all related and adjoining work.

E. See Section 01 91 00 – Commissioning – for additional work associated with this section.

F. Section 01 78 30 “Warranties and Bonds – CMR” for warranty requirements applicable to the work of this Section.

1.2 SCOPE OF WORK

A. This Section covers fire alarm systems, including initiating devices, notification appliances, controls, and supervisory devices.

B. Scope of work consists of installation of materials to be furnished under this Section, and without limiting generality thereof consists of furnishing labor, materials, equipment, hoisting, plant, transportation, rigging, staging, appurtenances, and services necessary and/or incidental to properly complete all fire alarm system work as shown on the drawings, as described in these specifications, or as reasonably inferred from either as being required in opinion of the Architect and Engineer.

C. Work Included: Provide complete electrical services where shown on the drawings, as specified herein and as needed for a complete and proper installation including but not necessarily limited to:

1. General.
2. Conduits, Raceways, and Back Boxes.
3. Wiring.
4. Fire Alarm Control Panel with Integral Voice Evacuation System.
5. Remote Annunciators.
6. Remote Microphones.
7. Initiation Devices.
8. Notification Devices.
9. Monitor and Control Devices.
10. Equipment Labeling.

11. Programming.

12. Testing.

1.3 SPECIFIED EQUIPMENT

A. Basis of design manufacturer: Notifier. Provide basis of design products, as specified herein, or comparable products in Siemens or Edwards (EST) manufacture.

B. The equipment and service provider shall be a nationally recognized company specializing in fire alarm and detection systems. This provider shall employ factory trained and NICET (minimum Level III Fire Alarm Technology) certified technicians on site to guide the installation, programming, and final systems check-out to ensure the systems integrity. The equipment and service provider shall maintain a service organization within 50 miles of this project location and shall have a minimum of 10 years experience in the fire protective signaling systems industry.

1.4 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

1. Product data sheets for all system components highlighted to indicate the specific products, features, or functions required to meet this specification.

2. Standard wiring diagrams from manufacturer.

3. Shop drawings in AutoCAD format showing system details including location of FACP, remote annunciators, remote microphones, all devices, and circuiting.

4. Complete system riser diagram showing all equipment and devices and wiring requirements for the entire system.

5. System power and battery charts with performance graphs, voltage drop calculations, and battery calculations to assure that the system will operate in accordance with the prescribed backup time periods and under all voltage conditions per UL and NFPA standards.

6. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of IDC, SLC, NAC, relay, sensor, and auxiliary control circuits.

7. Operating instructions for FACP.

8. Operation and maintenance data for inclusion in Operating and Maintenance Manual. Include data for each type product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations.

9. Product certification signed by the manufacturer of the fire alarm system components certifying that their products comply with indicated requirements.

B. Submission to Authority Having Jurisdiction: In addition to submission of the above material, make an identical submission to the authority having jurisdiction. Include copies of shop drawings as required to depict component locations to facilitate review. Upon receipt of comments from the Authority, make resubmissions, if required, to make clarifications or revisions to obtain approval.

1.5 WARRANTY

A. All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for the warranty period specified in Section 01 78 30 "Warranties and Bonds – CMR". The full cost of travel, maintenance, labor, and materials required to correct any defect(s) during this period shall be included in the submittal bid.

1.6 MAINTENANCE SERVICE

A. Maintenance Service Contract: Provide maintenance of fire alarm systems and equipment for a period of 18 months, using factory-authorized service representatives. Maintenance shall be in accordance with NFPA-72 and NFPA-720.

B. Basic Services: Systematic, routine maintenance visits on a quarterly basis at times scheduled with the Owner. In addition, respond to service calls within 24 hours of notification of system trouble. Adjust and replace defective parts and components with original manufacturer's replacement parts, components, and supplies.

C. Additional Services: Perform services within the above 18-month period not classified as routine maintenance or as warranty work when authorized in writing. Compensation for additional services must be agreed upon in writing prior to performing services.

D. Renewal of Maintenance Service Contract: No later than 60 days prior to the expiration of the maintenance services contract, deliver to the Owner a proposal to provide contract maintenance and repair services for an additional one-year term. Owner will be under no obligation to accept maintenance service contract renewal proposal.

1.7 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of the Contract Documents. A factory authorized installer is to perform the work of this section.

B. Each and every item of the Fire Alarm System shall be listed under the appropriate category by Underwriters Laboratories, Inc. (UL), and shall bear the "UL" label.

C. The fire alarm manufacturer shall be of the highest caliber and insist on the highest quality. The system shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.

D. Prior to bidding, the Contractor shall give written notice to the Engineer of any materials, equipment, or apparatus believed in the opinion of said Contractor, to be inadequate or unsuitable for the installation, or in violation of laws, ordinances, rules, or regulations of authorities having jurisdiction. The Contractor shall also give written notice to the Engineer of any items, materials, equipment, or work believed in the opinion of said Contractor, to be omitted from the Contract Documents. In the absence of such written notice, it is mutually agreed that the Contractor has included the cost of all required items in his bid and that he

will be responsible for approved satisfactory functioning of systems without further compensation.

1.8 GENERAL

A. This section of the specification includes the installation, connection and testing of microprocessor controlled, intelligent reporting fire alarm equipment and shall be required to form a complete, operative, coordinated system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, fire alarm remote control panels, auxiliary control devices, transponders, annunciators, and wiring as shown on the drawings and specified herein.

B. The fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.

C. The FACP and peripheral devices shall be manufactured 100% by a single U.S. manufacturer (or division thereof).

D. Basic Performance:

1. Alarm, trouble and supervisory signals from all intelligent reporting devices shall be encoded on NFPA Style 4 (Class B) Signaling Line Circuits (SLC).

2. Initiation Device Circuits (IDC) shall be wired Class B (NFPA Style B) as part of an addressable device connected by the SLC Circuit.

3. Notification Appliance Circuits (NAC) shall be wired Class B (NFPA Style Y) as part of an addressable device connected by the SLC Circuit.

4. Digitized electronic signals shall employ check digits or multiple polling.

5. A single ground or open on the system signaling line circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.

6. Alarm signals arriving at the main FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.

7. NAC speaker circuits shall be arranged such that there is a minimum of one speaker circuit per floor of the building or smoke zone whichever is greater.

8. Audio amplifiers and tone generating equipment shall be electrically supervised for normal and abnormal conditions.

9. NAC speaker circuits and control equipment shall be arranged such that loss of any one (1) speaker circuit will not cause the loss of any other speaker circuit in the system.

E. Basic system functional operation:

When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:

1. The system alarm LED on the FACP shall flash.

2. A local piezo electric signal in the control panel shall sound.

3. A backlit 80 character LCD display on the FACP shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.

4. Printing on the FACP and history storage equipment shall log the information associated each new fire alarm control panel condition, along with time and date of occurrence.

5. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

F. Software Modifications:

1. Provide the services of a factory trained and authorized technician to perform all system software modifications, upgrades or changes. Response time of the technician to the site shall not exceed 4 hours.

2. Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm system on site. Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones. The system structure and software shall place no limit on the type or extent of software modifications on-site. Modification of software shall not require power-down of the system or loss of system fire protection while modifications are being made.

G. Certifications:

1. Together with the shop drawing submittal, submit a certification from the major equipment manufacturer indicating that the proposed supervisor of the installation and the proposed performer of contract maintenance is an authorized representative of the major equipment manufacturer. Include names and addresses in the certification.

1.9 APPLICABLE CODES AND STANDARDS

The codes and standards listed below form a part of this specification.

A. National Fire Protection Association (NFPA) - USA:

No. 12	CO2 Extinguishing Systems
No. 12A & 12B	Halon Extinguishing Systems
No. 15	Water Spray Systems
No. 16	Foam/Water Deluge and Spray Systems
No. 72	National Fire Alarm Code
No. 101	Life Safety Code
N0. 720	Standard for the Installation of Carbon Monoxide Detection and Warning Equipment

B. Underwriters Laboratories Inc. (UL) - USA:

No. 268	Smoke Detectors for Fire Protective Signaling Systems
No. 864	Control Units for Fire Protective Signaling Systems
No. 268A	Smoke Detectors for Duct Applications
No. 521	Heat Detectors for Fire Protective
No. 464	Audible Signaling Appliances
No. 38	Manually Actuated Signaling Boxes
No. 346	Waterflow Indicators for Fire Protective Signaling Systems
No. 1076	Control Units for Burglar Alarm Proprietary Protective Signaling Systems
No. 1971	Visual Notification Appliances
No. 2034	Standard for Carbon Monoxide Alarms
N0. 2075	Standard for Gas and Vapor Detectors and Sensors

C. Local and State Building Codes.

D. All requirements of the Authority Having Jurisdiction (AHJ).

E. Distributor of fire alarm to be an approved UUJS certified company.

1.10 EXTRA MATERIALS

A. General: Furnish extra materials, packaged with protective covering for storage, and identified with labels clearly describing contents as follows:

1. Break Rods for Manual Stations: Furnish quantity equal to 15 percent of the number of manual stations installed; minimum of 6 rods.

2. Notification Appliances: Furnish quantity equal to 10 percent of each type and number of units installed, but not less than one of each type.

3. Smoke Detectors or Sensors, Fire Detectors, and Flame Detectors: Furnish quantity equal to 10 percent of each type and number of units installed but not less than one of each type.

4. Detector or Sensor Bases: Furnish quantity equal to 2 percent of each type and number of units installed but not less than one of each type.

PART 2.0 PRODUCTS

2.1 EQUIPMENT AND MATERIAL, GENERAL

A. All equipment and components shall be new, and the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protective signaling system, meeting the National Fire Alarm Code.

B. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.

C. All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.2 RACEWAYS AND WIRING

A. Conduit:

1. Conduit shall be in accordance with The National Electrical Code (NEC), and local and state requirements. Conduit shall be EMT with galvanized steel set screw type connectors and couplings. Conduits shall be ¾ inch diameter minimum.

2. All wiring in normally occupied (finished) areas of the building shall be installed concealed from view within the building structure. Wiring may only be installed exposed to view in Mechanical and Electrical Rooms, and rooms without ceilings (exposed to structure above). Provide minimum ¾” EMT conduit for wiring run within walls, above non-accessible ceilings, and where exposed to view.

B. Wire:

1. All fire alarm system wiring shall be type FPL where run in conduit or raceway and type FPLP Fire Alarm Cable where run without conduit or raceway. All wiring run above ceilings shall be provided in type FPLP Fire Alarm Cable.

2. Wiring shall be in accordance with local, state and national codes and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer.

3. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC Article 760-29.

4. Wiring for 24 volt DC control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.

5. Wiring used for the SLC multiplex communication loop shall be twisted and shielded and support a minimum wiring distance of 10,000 feet. In certain applications, the system shall support up to SLC loops with up to 1,000 feet of untwisted, unshielded wire. The system shall permit use of IDC and NAC wiring in the same conduit with the SLC communication loop.

6. All field wiring shall be completely supervised.

7. The fire alarm control panel shall be capable of t-tapping Class B (NFPA Style 4) Signaling Line Circuits (SLCs). Systems which do not allow or have restrictions in, for example, the amount of t-taps, length of t-taps etc., are not acceptable.

C. Device Boxes, Junction Boxes and Cabinets:

1. All boxes and cabinets shall be UL listed for their use and purpose.

2. All junction box covers shall be painted fire alarm red.

D. Initiating circuits shall be arranged to serve like categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.

E. The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a cold water pipe or grounding rod.

2.3 MAIN FIRE ALARM CONTROL PANEL

A. The specification is based on a Notifier Model NFS2-3030. The system shall contain a microprocessor based Central Processing Unit (CPU). The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators, and other system controlled devices.

B. Operator Control:

1. Acknowledge Switch:

a. Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If

multiple alarm or trouble conditions exist, depression of this switch shall advance the 80-character LCD display to the next alarm or trouble condition.

b. Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.

2. Alarm Silence Switch:

a. Activation of the alarm silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition after an alarm condition. The selection of notification circuits and relays that are silence able by this switch shall be fully field programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.

3. Alarm Activate (Drill) Switch:

a. The Alarm Activate switch shall activate all notification appliance circuits. The drill function shall latch until the panel is silenced or reset.

4. System Reset Switch:

a. Activation of the System Reset switch shall cause all electronically-latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition.

5. Lamp Test:

a. The Lamp Test switch shall activate all system LEDs and light each segment of the liquid crystal display.

C. System Capacity and General Operation:

1. The control panel shall provide, or be capable of expansion to 636 intelligent/addressable devices.

2. The system shall include Form-C alarm, trouble, supervisory, and security relays rated at a minimum of 3.0 amps @ 30 VDC. It shall also include four Class B (NFPA Style Y) or Class A (NFPA Style Z) programmable notification appliance circuits.

3. The system shall support up to 8 additional output modules (signal, speaker, telephone, or relay), each with 8 circuits for an additional 64 circuits. These circuits shall be either Class A (NFPA Style D) or Class B (NFPA Style Y) per the project drawings.

4. The fire alarm control panel shall include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color coded system status LEDs, and an alphanumeric keypad for the field programming and control of the fire alarm system.

5. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel. The system shall be fully programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes.

6. The system shall allow the programming of any input to activate any output or group of outputs. Systems which have limited programming (such as general alarm), have complicated programming (such as a diode matrix), or require a laptop personal computer are not considered suitable substitutes.

7. The FACP shall provide the following features:

   a. Drift compensation to extend detector accuracy over life. Drift compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.

   b. Detector sensitivity test, meeting requirements of NFPA 72, Chapter 7.

   c. Maintenance alert, with two levels (maintenance alert/maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.

   d. Nine sensitivity levels for alarm, selected by detector. The system shall also include up to nine levels of pre-alarm, selected as a percentage of the alarm level, in steps from 90% down to 50%.

   e. System status reports to display or printer.

   f. Alarm verification, with verification counters.

   g. PAS pre-signal, meeting NFPA 72 3-8.3 requirements.

   h. Rapid manual station reporting (under 3 seconds).

   i. Non-alarm points for general (non-fire) control.

   j. Periodic detector test, conducted automatically by the software.

   k. Self optimizing pre-alarm for advanced fire warning, which allows each detector to learn its particular environment and set its pre-alarm level to just above normal peaks.

   l. Cross zoning with the capability of counting: two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.

   m. Walk test, with a check for two detectors set to same address.

   n. Control-by-time for non-fire operations, with holiday schedules.

o. Day/night automatic adjustment of detector sensitivity.

p. Device blink control for sleeping areas.

q. UL-1076 security monitor points.

D. The FACP shall be capable of coding notification circuits in march time (120 PPM), temporal (NFPA 72 A-2-2.2.2), and California code.

E. Central Microprocessor

1. The microprocessor shall be a state-of-the-art, high speed, 16 bit RISC device and it shall communicate with, monitor and control all external interfaces. It shall include an EPROM for system program storage, non-volatile memory for building-specific program storage, and a "watch dog" timer circuit to detect and report microprocessor failure.

2. The microprocessor shall contain and execute all control-by-event programs for specific action to be taken if an alarm condition is detected by the system. Control-by-event equations shall be held in non-volatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs.

3. The microprocessor shall also provide a real-time clock for time annotation of system displays, printer, and history file. The time-of-day and date shall not be lost if system primary and secondary power supplies fail. The real time clock may also be used to control non-fire functions at programmed time-of-day, day-of-week, and day-of-year.

E. Display

1. The display shall provide all the controls and indicators used by the system operator and may also be used to program all system operational parameters.

2. The display shall include status information and custom alphanumeric labels for all intelligent detectors, addressable modules, internal panel circuits, and software zones.

3. The display shall include an 640-character back-lit alphanumeric Liquid Crystal Display (LCD). It shall also provide a minimum of 8 Light-Emitting-Diodes (LEDs) that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM WARNING, SECURITY ALARM, SUPERVISORY SIGNAL, SYSTEM TROUBLE, DISABLED POINTS, and ALARM SILENCED.

4. The display shall include the following operator control switches: ACKNOWLEDGE, ALARM SILENCE, ALARM ACTIVATE (drill), SYSTEM RESET, and LAMP TEST.

F. Signaling Line Circuits (SLC)

1. The system shall include a minimum of 6 SLC circuits. Each SLC interface shall provide power to and communicate with up to 159 intelligent detectors (ionization, photoelectric or thermal) and 159 intelligent modules (monitor or control) for a system capacity of 636 devices. Each SLC loop shall be capable of NFPA 72 Style 4, Style 6, or Style 7 (Class A or B) wiring.

2. The Loop Interface Board (LIB) shall receive analog information from all intelligent detectors to be processed to determine whether normal, alarm, pre-alarm, or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information shall also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.

3. The detector software shall meet NFPA 72, Chapter 7 requirements and be certified by UL as a calibrated sensitivity test instrument.

4. The detector software shall allow manual or automatic sensitivity adjustment.

G. Notification Appliance Circuit (NAC) Module

1. The notification appliance circuit transponder module shall provide fully supervised Class A or B (NFPA Style Z or Y) notification circuits.

2. The notification circuit capacity shall be 3.0 amperes maximum per circuit and 6.0 amperes maximum per module.
3. The module shall not affect other module circuits in any way during a short circuit condition.

I. Control Transponder Relay Module

1. The control relay transponder module shall provide Form-C auxiliary relay circuits rated at 5 amperes, 28 VDC.

2. Each relay circuit shall be capable of being activated (change in state) by any initiating device or from any combination of initiating devices.

J. Digital Voice Control Transponder Module

1. The voice control (speaker circuit) module shall provide fully supervised Class B (NFPA Style Y) or Class A (NFPA Style Z) speaker circuits.

2. Each speaker circuit shall be capable of switching up to 30 watts maximum per circuit.

3. If a short-circuit trouble occurs on one of the circuits, that circuit will not activate on either manual or automatic command.

4. Each speaker circuit module may be programmed to activate on activation of the All-Call switch and to deactivate upon pressing the signal silence switch.

K. Enclosures:

1. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.

2. The back box and door shall be constructed of .060 steel with provisions for electrical conduit connections into the sides and top.

3. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be selected for either right or left hand hinging.

L. Digital Voice Command Center (DVCC)

1. The Digital Voice Command Center (DVCC) shall contain equipment required for all audio control, telephone system control, signaling and supervisory functions. This shall include amplifiers, tone generators, digital voice units, a microphone and a main telephone handset. The voice command center shall be an integral part of the fire alarm system. Systems which require separate, non-integrated voice systems are not considered suitable substitutes.

M. Power Supply:

1. The main addressable-intelligent power supply for the fire alarm control panel shall provide 5.0 amps of available power for the control panel and peripheral devices.

2. Provisions will be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.

3. The main power supply shall continuously monitor all field wires for earth ground conditions, and shall have the following LED indicators:

a. Ground Fault LED
b. Battery Fail LED
c. AC Power Fail LED

4. The main power supply shall operate on 120 VAC, 60 Hz, and shall provide all necessary power for the FACP.

5. The main power supply shall provide a battery charger for 24 hours of standby using dual-rate charging techniques for fast battery recharge.

N. Audio Amplifiers (Size amplifiers with a minimum spare capacity of 20% and provide a minimum of one backup amplifier.)

1. The audio amplifiers will provide audio power (@ 25 Volts RMS) for distribution to the speaker circuits.

2. Multiple audio amplifiers may be mounted in the fire alarm control panel using additional cabinets if necessary.

3. The audio amplifiers shall include an integral power supply, and shall provide the following controls and indicators:

   a. Normal Audio Level LED
   b. Incorrect Audio Level LED
   c. Brownout LED
   d. Battery Trouble LED
   e. Amplifier Trouble LED
   f. Audio Amplifier Gain Adjust

4. Adjustment of the correct audio level for the amplifier shall not require any special tools or test equipment.

5. All terminal blocks for the connection of field wiring shall have a removable plug-in and be hardwired to allow for ease of field wire installation in a cabinet or at a remote location.

6. The amplifier shall include audio input and amplified output supervision, back-up input, and automatic switch-over to back up (if primary amplifier should fail).

7. Amplifiers shall be backed up in groups (one amplifier backs up several).

O. Prerecorded Voice - Audio Message Generator

1. The voice communication system shall be capable of transmitting a prerecorded voice message to all speakers in the building, or to any programmed group of speakers.

2. Actuation of any alarm initiating device shall cause a pre-recorded message to sound over the speakers. The message shall be repeated four times.

3. A built-in microphone shall be provided to allow paging through speaker circuits and shall have priority over the alarm message.

P. Specific System Operations

1. Smoke Detector Sensitivity Adjust: A means shall be provided for adjusting the sensitivity of any or all addressable intelligent detectors in the system from the system keypad. Sensitivity range shall be within the allowed UL window and have a minimum of 9 levels.

2. Waterflow Operation (Provide one FMM-1 for each)

a. An alarm from a waterflow detection device shall activate the appropriate alarm message on the 80 character display, turn on all programmed notification appliance circuits and shall not be affected by the signal silence switch.

3. Supervisory Operation (Provide one FMM-1 for each)

2.4 SYSTEM COMPONENTS

A. Speakers (Speaker/Strobes "SPSR" Notifier are to meet requirements of both paragraphs A and B)

1. All speakers shall operate on 25 VRMS or with field selectable output taps from 0.5 to 2.0 Watts.

2. Speakers in corridors and public spaces shall produce a nominal sound output of 84 dBA at 10 feet (3m).

3. Frequency response shall be a minimum of 400 HZ to 4000 HZ.

4. The back of each speaker shall be sealed to protect the speaker cone from damage and dust.

B. Strobe lights shall meet the requirements of the ADA, UL Standard 1971, NFPA and shall meet the following criteria:

1. The pulse duration shall be between minimum of one second and maximum of two seconds.

2. Strobe intensity shall meet the requirements of UL 1971, NFPA and ADA.

3. All visual units shall be synchronized to meet ADA requirements using sync modules.

C. Alphanumeric LCD Type Annunciator

1. The alphanumeric display annunciator shall be a supervised, remotely located back-lit LCD display containing a minimum of one hundred-sixty (160) characters for alarm annunciation in clear English text.

2. Provide annunciator key switch to enable or disable operation of annunciator membrane control switches.

D. Transponders

1. Transponders shall be listed under UL category UOJZ as an independent, local fire alarm control unit as well as being listed as a critical component in a multiplex fire alarm system. Transponders shall be located where shown on the plans. The transponder(s) shall serve as the interface between initiating fire devices, controlled signaling devices, and each FACP node. The

supervised multiplex communication port shall be an integral part of the transponder.

2. Each transponder shall be powered from a local power supply, and shall provide all power necessary for its own operation, including standby power.

2.5 SYSTEM COMPONENTS - ADDRESSABLE DEVICES

A. Addressable Manual Pull Box (NBG12LX)

1. Addressable pull boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.

2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.

3. Manual stations shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches or larger.

4. Stations shall be suitable for surface mounting or semi-flush mounting as shown on the plans, and shall be installed not less than 42 inches, nor more than 48 inches above the finished floor.

5. Provide STI Stopper II Lexan guards with integral buzzer for all manual pull stations.

B. Intelligent Photoelectric Smoke Detector FSP-851)

1. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

C. Intelligent Thermal Detectors (FST-851 or FST-851H)

1. Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit. Up to 159 intelligent heat detectors may connect to one SLC loop.

D. Intelligent Duct Smoke Detector (DNR with FSP-851R and tube)

1. The in-duct smoke detector housing shall accommodate either an intelligent ionization detector or an intelligent photoelectric detector, of that provides continuous analog monitoring and alarm verification from the panel.

2. When sufficient smoke is sensed, an alarm signal is initiated at the FACP, and appropriate action taken to change over air handling systems to help prevent the rapid distribution of toxic smoke and fire gases throughout the areas served by the duct system.

E. Addressable Dry Contact Monitor Module (FMM-1)

1. Addressable monitor modules shall be provided to connect one supervised IDC zone of conventional alarm initiating devices (any N.O. dry contact device) to one of the fire alarm control panel SLC loops.

2. The monitor module shall mount in a 4-inch square, 2-1/8 inch deep electrical box.

F. Addressable Control Module (FCM-1)

1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contract relay.

2. The control module shall mount in a standard 4-inch square, 2-1/8 inch deep electrical box, or to a surface mounted backbox.

3. The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation, or as a dry contact (Form-C) relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

4. Audio/visual power shall be provided by a separate supervised power loop from the main fire alarm control panel or from a supervised, UL listed remote power supply.

5. The control module shall be suitable for pilot duty applications and rated for a minimum of .6 amps at 30 VDC.

G. Intelligent smoke detector / CO detector (FCO-851)

1. The intelligent smoke detector / CO detector shall provide separate and distinct audible tones and shall activate a supervisory signal on the fire alarm panel and LCD annunciators when in alarm. CO detectors shall not initiate a general building alarm when activated.

2. Intelligent smoke detector/CO detector installation shall be in accordance with NFPA-720.

2.6 BATTERIES

A. The batteries shall be 55 amp-hour, 12 volt nominal (two required).

B. The battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.

C. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.

2.7 UDACT

A. Provide a universal digital alarm communicator/transmitter capable of annunciating all addressable devices to a centralized monitoring station.

B. The communicator shall annunciate all devices on an individual point basis. Communicator shall be UL listed for fire and include dual telephone line connections.

PART 3.0 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install system components and all associated devices in accordance with applicable NFPA Standards and manufacturer's recommendations.

B. Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of fire alarm systems.

C. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

D. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

3.2 EQUIPMENT INSTALLATION

A. Furnish and install a complete Fire Alarm System as described herein and as shown on the plans. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes, and all other necessary material for a complete operating system.

B. Water-Flow and Valve Supervisory Switches: Connect for each sprinkler valve required to be supervised.

C. Device Location-Indicating Lights: Locate in the public space immediately adjacent to the device they monitor.

D. Install manual station with operating handle 48 inches (1.22 m) above floor. Install wall mounted audible and visual notification appliances not less than 80 inches (2.03 m) above floor to bottom of lens and not greater than 96 inches (2.44 m) above floor to top of lens.

E. Make conduit and wiring connections to door release devices, sprinkler flow switches, sprinkler valve tamper switches, pre-action system control panel, duct smoke detectors.

F. Automatic Detector Installation: Conform to NFPA 72.

3.3 PREPARATION

A. Coordinate work of this Section with other affected work and construction schedule.

3.4 WIRING INSTALLATION

A. System Wiring: Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the Authority Having Jurisdiction and shall be installed in accordance with the appropriate articles from the current approved edition of NFPA 70: National Electric Code (NEC).

B. Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.

C. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code notification appliance circuits differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.

B. Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems.

C. Pre-testing: Determine, through pre-testing, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pre-testing. Replace any malfunctioning equipment, devices, or wiring.

D. Inspection:

1. Inspect equipment installation, interconnection with system devices, mounting locations, and mounting methods.

2. Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.

E. Programming:

1. System device addresses shall be based on the owners chosen room numbering system. The contractor shall obtain the final room numbers from the architect and owner prior to system programming. All system devices shall be labeled by the contractor with the device address using a Dymo labeling machine. Labels shall be black numerals (3/32” numeral height) on clear background.

2. Provide all system programming as required to meet the specified operation. In addition, include in the bid for 3 additional system-wide software programming changes to meet the requirements of the Owner, Engineer, or local Fire Department.

F. Acceptance Operational Tests:

1. Perform operational system tests to verify conformance with specifications: Each alarm initiating device installed shall be operationally tested. Each device shall be tested for alarm and trouble conditions. Contractor shall submit a written certification that the Fire Alarm System installation is complete including all punch-list items. Test battery operated emergency power supply.

   Test emergency power supply to minimum durations specified. Test Supervising Station Signal Transmitter. Coordinate testing with Supervising Station monitoring firm/entity. Test each Notification Appliance installed for proper operation. Submit written report indicating sound pressure levels at specified distances.

   Test Fire Alarm Control Panel and Remote Annunciators.

2. Provide minimum 10 days notice of acceptance test performance schedule to Owner, and local Authority Having Jurisdiction.

G. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

H. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Use NFPA 72 Forms for documentation. Comply with NFPA-720 for CO detectors.

I. Final Test, Record of Completion, and Certificate of Occupancy:

1. Test the system as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy. Provide completed NFPA 72 Record of Completion form to Owner and AHJ.

3.6 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Clean units internally using methods and materials recommended by manufacturer.

B. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound pressure levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

3.7 TRAINING

A. Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel as specified below.

1. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of two (2) separate 4 hour training sessions.

2. Schedule training with the Owner at least seven days in advance.

END OF SECTION 28 31 00

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. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Removing existing surface, buried and partially buried boulders, as well as above- and below-grade site improvements.
4. Clearing and grubbing.
5. Stripping and stockpiling topsoil.
6. **Legal disposal off site of all bituminous pavements indicated for removal.**

B. Related Requirements:

1. Section 01 50 00 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.
2. Section 31 20 00 “Earth Moving” for satisfactory soil materials.

1.3 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.

D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.

E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.

G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and **shall be removed from Project site.**

1.6 SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

B. Topsoil stripping and stockpiling program.

C. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.7 QUALITY ASSURANCE

A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

1.8 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises.

D. Utility Locator Service: Notify Call Before You Dig for area where Project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

F. Tree- and Plant-Protection Zones: Protect according to requirements in Section 01 56 39 "Temporary Tree and Plant Protection."

G. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 31 20 00 "Earth Moving."

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

2. **Demolished bituminous pavements are waste materials and shall be removed from the site and legally disposed of.**

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site.

3.3 EXISTING UTILITIES

A. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.

2. Do not proceed with utility interruptions without Architect's written permission.

3.4 EXISTING BOULDERS

A. All existing boulders, both those sitting on the surface or partially buried, are to be removed.

B. All boulders shall be removed from the site and legally disposed of.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.

2. Grind down stumps and remove roots larger than 2 inches in diameter, obstructions, and debris to a depth of 24 inches below exposed subgrade.

3. Use only hand methods or air spade for grubbing within protection zones.

4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

1. Limit height of topsoil stockpiles to 72 inches.

2. Do not stockpile topsoil within protection zones.

3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.

4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, **demolished materials, and waste materials** including trash and debris, and legally dispose of them off Owner's property.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 31 10 00

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Supplementary Conditions, and Division 1 Specification sections, apply to this section.

1.2 SUMMARY

A. Provide all labor, materials and equipment required to perform the work called for in this section of the Specification, or as shown on the drawings, including but not necessarily limited to the following:

1. Removal of all existing concrete and bituminous concrete from within the limits of trench excavation as indicated on the plans, or as directed.
2. Removal of existing utilities as indicated on the drawings. Abandonment of existing utilities as indicated on the drawings.
3. Protection of all site elements to remain including but not limited to railings, utilities and all other items identified on the drawings.
4. Provide temporary utility services as indicated on the drawings or as directed.
5. Provide temporary surface treatments such as pavement and walkways as shown on the drawings or as directed.

B. Related work:

1. Division 01 Section “Maintenance and Protection of Traffic”
2. Division 02 Section “Test Pits”
3. Division 31 Section "Trenching and Backfilling"
4. Division 31 Section "Stormwater Pollution and Control Plan (SWPCP)"
5. Division 32 Section "Bituminous Asphalt Concrete Paving"
6. Division 33 Section “Site Water Utility Distribution Piping”
7. Division 33 Section “Sanitary Utility Sewerage Piping”
8. Division 33 Section “Storm Utility Drainage Piping”
9. Division 33 Section “Natural Gas Distribution Piping”

1.3 SUBMITTALS

A. Schedule:

1. Submit two copies of proposed methods and plan of operations for demolition of existing utilities to the Owner for review prior to the start of work. Include in the plan the coordination for shut-off, capping and continuation of utility services as required.
2. Submit copies of all permits required for utility demolition work and transporting debris including certificates for severance of utility service.

B. The Contractor shall submit for review a detailed **Sequence of Construction Plan** for all construction that differs from the guidelines set forth in the Contract Documents or if not completely defined in the Contract Documents to allow for Contractor flexibility. Sequence of Construction Plan shall include provisions for Emergency Operations due to weather, or any other site emergency. No work shall be allowed until Sequence of Operations plan is approved by the Owner's Representative and the Engineer.

1.4 QUALITY ASSURANCE

A. Codes and Regulations: Work shall be performed in strict accordance with the terms and conditions of all current Municipal and State statutes including OSHA. It shall be the Contractor's responsibility to determine all such statutes, codes and regulations that are applicable or otherwise govern the performance of the work.

B. The Contractor shall obtain and pay for all permits, fee and licenses required to perform the work.

1.5 JOB CONDITIONS

A. Protection:

1. Prevent movement or settlement of adjacent structures. Provide and place bracing, shoring and underpinning and be responsible for safety and support of structures. Assume liability for such movement, settlement, damage, or injury. Provide services of registered Structural Engineer to design bracing, shoring and/or underpinning if this work is required.

2. Cease operations and notify Architect/Engineer immediately if safety of adjacent structures appears to be endangered. Take precautions to properly support structures. Do not resume operations until safety is restored.

3. Prevent movement, settlement or collapse of adjacent services, sidewalks, driveways and trees. Assume liability for such movement, settlement or collapse. Promptly repair damage at no cost to the Owner.

4. Provide, erect and maintain street boardings, sidewalk sheds, barricades, lighting and guardrails as required to protect general public, workers, and adjoining property.

B. Utilities:

1. Arrange and pay for disconnecting, removing, capping and plugging utility services. Disconnect and stub off. Notify the affected utility companies in advance and obtain approval before starting this work.

2. Place markers to indicate location of disconnected services. Identify service lines and capping locations on Project Record Documents.

C. Maintaining Traffic:

1. Conduct demolition operations and the removal of debris to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities.

2. Do not close or obstruct streets, walks or other occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations.

D. Explosives: The use of explosives will not be permitted.

PART 2 - PRODUCTS – Not used.

PART 3 - EXECUTION

3.1 GENERAL

A. Conduct site utility demolition and preparation to ensure minimum interference with roads and adjacent property owners and as required by the Owner.

B. Refer to Construction Documents for Construction Phasing and requirements and limitations on site clearing and grubbing.

C. Prior to any excavation, the Contractor shall notify all affected utilities in accordance with Public Act 77-350 ("Call Before You Dig": 1-800-922-4455).

D. All sedimentation control devices as shown on the plans, or as directed, shall be installed prior to any excavation activities or stump removal. Construction methods shall conform to Article 2.19.03 of the Form 817. See Section 312500 of the specifications.

E. Disposal of excavated material shall be in accordance with Federal, State and local regulations.

F. Excavate material, as required.

G. Existing trees that are to remain shall be adequately protected to ensure that they are not damaged.

H No burning of material will be allowed.

I. Existing bituminous and concrete pavement to remain shall be saw-cut in a neat line.

J. Contractor shall secure site at the end of each day and at the end of each week. No open trenches, excavations shall be allowed. At the end of each week the Owner's Representative shall complete an inspection of the site including security, erosion controls and any other construction feature. The Contractor shall make any required modifications at no cost to the Owner and to the satisfaction of the Owner's Representative.

K. During the progress of the work, keep all adjacent sidewalks, drives and town streets clean and free of dirt and debris.

3.2 HAZARDOUS MATERIAL AND WASTE CONTROL

A. Excavation and disposal of contaminated, polluted or "environmentally compromised" materials shall be conducted in conformance with the environmental and abatement specifications. The handling of contaminated polluted or "environmentally compromised" water to be discharged as a result of dewatering shall be performed in accordance with the environmental and abatement specifications.

END OF SECTION 31 11 00

ISSUED for BID

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.

B. Geotechnical Study for Proposed New Building and included in Section 00 31 32.13 Subsurface Geotechnical Report.

C. In-Situ Soil Characterization and Soil Reuse Guidance - Determination letter for Ella Grasso Technical High School, Dated January 05, 2021.

1.2 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site. (All excavations for this project will be considered as unclassified excavation).
2. Preparing subgrades for slabs-on-grade, walks, pavements, turf, grasses and plants.
3. Drainage course for concrete slabs-on-grade.
4. Base course for concrete walks pavements.
5. Subbase course and base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavation, removal and legal disposal of contaminated and polluted soils.
8. Excavation, removal and legal disposal of excess soil materials.

B. Related Requirements:

1. Refer to Division 1 Section “Allowances and Contract Considerations” for allowances and unit prices affecting the Work of this Section.
2. Section 01 32 33 "Photographic Documentation" for recording pre-excavation and earth-moving progress.
3. Section 03 30 00 "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
4. Section 31 10 00 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
5. Section 31 11 00 “Site Utility Preparation and Demolition for removal, abandonment or protection of existing utilities.
6. Section 31 23 16 “Structural Excavation and Fill” for excavation and backfill of structures and roadways.
7. Section 31 23 16.26 “Rock Removal” for complete removal of rock off-site in areas of cut and fill.
8. Section 31 23 19 "Dewatering" for lowering and disposing of ground water during construction.

9. Section 31 23 33 “Trenching and Backfilling” for excavating, backfilling and compacting for utilities.
10. Section 31 25 00 “Storm Water Pollution and Control Plan” for slope protection and erosion control devices.
11. Section 31 41 00 "Excavation Support" for support systems of structure, shoring, and trench excavations.
12. Section 32 12 16 “Asphalt Paving” for base materials requirements for asphalt pavements.
13. Section 32 92 00 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
14. Section 32 93 00 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

1.3 REFERENCE STANDARDS

A. Form 817 shall mean the State of Connecticut, Department of Transportation Standard Specifications for Roads, Bridges and Incidental Construction Form 817-2019 or its latest edition and any supplemental specifications, except as noted otherwise in these documents.

1.4 UNIT PRICES

A. Work of this Section is affected by unit prices for earth moving specified in Section 012000 “Allowances and Contract Considerations.”

B. Quantity allowances for earth moving are included in Section 012000 “Allowances and Contract Considerations.”

C. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following. Unit prices for rock excavation include replacement with approved materials.

1. 24 inches (600 mm) outside of concrete forms other than at footings.
2. 12 inches (300 mm) outside of concrete forms at footings.
3. 6 inches (150 mm) 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 (150 mm) beneath bottom of concrete slabs-on-grade.
6. 6 inches (150 mm) beneath pipe in trenches, and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.

1.5 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material 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: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

2. Bulk Excavation: Excavation more than 10 feet (3 m) in width and more than 30 feet (9 m) in length.

3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 1 cu. yd. (0.76 cu. m) for bulk excavation or 3/4 cu. yd. (0.57 cu. m) 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, ripping, or blasting, when permitted:

1. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- (1065-mm-) maximum-width, short-tip-radius rock bucket; rated at not less than 138-hp (103-kW) flywheel power with bucket-curling force of not less than 28,700 lbf (128 kN) and stick-crowd force of not less than 18,400 lbf (82 kN) with extra-long reach boom.

2. Equipment for Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp (172-kW) flywheel power and developing a minimum of 47,992-lbf (213.3-kN) breakout force with a general-purpose bare bucket.

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: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.6 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct pre-excavation conference at Project site.

1. Review methods and procedures related to earthmoving, including, but not limited to, the following:
    a. Personnel and equipment needed to make progress and avoid delays.
    b. Coordination of Work with utility locator service.
    c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
    d. Coordination of Work and equipment with the removal of contaminated and polluted soils from the site.
    e. Extent of trenching by hand or with air spade.
    f. Field quality control.

1.7 SUBMITTALS

A. Product Data: For each type of the following manufactured products required:
    1. Geotextiles.
    2. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:
    1. Geotextile: 12 by 12 inches (300 by 300 mm).
    2. Warning Tape: 12 inches (300 mm) long; of each color.

C. Qualification Data: For qualified testing agency.

D. Material Test Reports: For each on-site and borrow soil material proposed for fill and backfill as follows:
    1. Classification according to ASTM D 2487.
    2. Laboratory compaction curve according to ASTM D 1557.

E. Soil Management Plan for the documentation of excavation, removal and disposal of contaminated and polluted soils from the site.
    1. Include methods to be used to document the horizonal and vertical control of the excavations, to isolate the contaminated and polluted soils for excavation and removal from the site.

F. Blasting plan approved by authorities having jurisdiction.

G. Seismic survey report from seismic survey agency.

H. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

1.8 QUALITY ASSURANCE

A. Blasting: Comply with applicable requirements in NFPA 495, "Explosive Materials Code," and prepare a blasting plan reporting the following:
    1. Types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.

2. Seismographic monitoring during blasting operations.

B. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:

1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.

2. Seismographic monitoring during blasting operations.

C. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

1.9 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.

2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.

1. Do not proceed with work on adjoining property until directed by Architect.

C. Utility Locator Service: Notify "Call Before You Dig" for area where Project is located before beginning earth-moving operations.

D. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in Section 015000 "Temporary Facilities and Controls" and Section 311000 "Site Clearing" are in place.

E. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.

F. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.

2. Parking vehicles or equipment.

3. Foot traffic.

4. Erection of sheds or structures.

5. Impoundment of water.

6. Excavation or other digging unless otherwise indicated.

7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

G. Do not direct vehicle or equipment exhaust towards protection zones.

H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 WASTE MATERIALS

A. Demolished bituminous pavements are waste materials and shall be removed from the site and legally disposed of.

1. Bituminous pavements shall not be mixed with on-site soils or re-used as soil materials on site.

2.2 BOULDERS

A. Boulders encountered on-site can be placed in fills below a depth of 6 feet from base or sub-base course elevations.

1. Boulders must be spread apart a minimum of 4 feet to permit placement and compaction of soil between the boulders.

2. It may be necessary to place off site sand in some areas around the boulders to preclude voids in the fills.

B. Alternatively, the boulders can be crushed before placement in fill.

1. Crushed boulders must meet the requirements of Form 817 Article M.02.06 Gradation B, or as indicated if used in the soil materials below.

2.3 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Unsatisfactory Soils: Soil Classification Groups SC, CL, ML, OL, CH, MH, OH, SM and PT according to ASTM D 2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction. **No changes in the Contract Sum or the Contract Time will be authorized for unsatisfactory soils excavation or removal work included in the bid package.**

C. Subbase Material: Conform to Form 817, Section 2.12 Subbase and Articles M.02.02 and M.02.06.

D. Granular Fill: Conform to Form 817, Section 2.13 Granular Fill and Article M.02.01.

E. Compacted Granular Fill: Conform to Form 817, Section 2.14 Compacted Granular Fill and Article M.02.02.

F. Granular Base: Conform to Form 817 Article M.02.03 and Article M.02.06 Gradation C.

G. Processed Aggregate Base: Conform to Form 817 Section 3.04 Processed Aggregate Base and to Article M.05.01.

H. Controlled Fill shall be 3/8” Crushed Stone.

I. 3/8” Crushed Stone: Conform to Form 817, Article M.01.01, No. 8 Stone.

J. ¾” Crushed Stone: Conform to Form 817, Article M.01.01, No. 6 Stone

K. 1 ¼” Crushed Stone: Conform to Form 817, Article M.01.01, No. 4 Stone.

L. Modified Riprap: Conform to Form 817, Article M.12.03.

M. Sand: ASTM C 33/C 33M; fine aggregate.

N. Stone Dust: Conform to Form 817, Article M.01.01, Screenings.

2.4 GEOTEXTILES

A. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Survivability: As follows:
    a. Grab Tensile Strength: 247 lbf (1100 N); ASTM D 4632.
    b. Sewn Seam Strength: 222 lbf (990 N); ASTM D 4632.
    c. Tear Strength: 90 lbf (400 N); ASTM D 4533.
    d. Puncture Strength: 90 lbf (400 N); ASTM D 4833.
3. Apparent Opening Size: No. 60 (0.250-mm) sieve, maximum; ASTM D 4751.
4. Permittivity: 0.02 per second, minimum; ASTM D 4491.
5. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

2.5 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility; 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.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) 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 (750 mm) 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 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

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.

3.3 EXPLOSIVES

A. Explosives: Obtain written permission from authorities having jurisdiction before bringing explosives to Project site or using explosives on Project site.

1. Perform blasting without damaging adjacent structures, property, or site improvements.

2. Perform blasting without weakening the bearing capacity of rock subgrade and with the least-practicable disturbance to rock to remain.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. **No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions work included in the bid package.**

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:

a. 24 inches (600 mm) outside of concrete forms other than at footings.

b. 12 inches (300 mm) outside of concrete forms at footings.

c. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.

d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.

e. 6 inches (150 mm) beneath bottom of concrete slabs-on-grade.

f. 6 inches (150 mm) beneath pipe in trenches and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.

3.5 EXCAVATION FOR SITE STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations of site walls: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

2. Pile Foundations: Conform to Section 31 23 16 “Structural Excavation and Fill” for excavation and backfill of structures.

3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Conform to Section 31 23 33 “Trenching and Backfilling” for excavating, backfilling and compacting for utilities.

B. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Conform to Section 31 23 33 “Trenching and Backfilling” for excavating, backfilling and compacting for utilities.

3.8 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes) to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).

2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory 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 remaining trees.

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, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.12 UTILITY TRENCH BACKFILL

A. Conform to Section 31 23 33 “Trenching and Backfilling” for excavating, backfilling and compacting for utilities.

3.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil 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 SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials 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 (300 mm) of existing subgrade and each layer of backfill or fill soil material at 95 percent.

2. For deep fill slopes:

a. Fill in 8” lifts maximum.

b. Upper 6’ of fill compact each layer of backfill or fill material at 95 percent.

c. Fill below the upper 6’ of fill, compact each layer of backfill or fill material at 93 percent.

3. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 92 percent.

4. Under turf or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 85 percent.

5. For utility trenches, compact each layer of initial and final backfill soil material at 85 percent.

3.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of 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.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch (25 mm).

2. Walks: Plus or minus 1 inch (25 mm).

3. Pavements: Plus or minus 1/2 inch (13 mm).

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.17 SUBSURFACE DRAINAGE

A. Subdrainage Pipe: Specified in Section 334100 "Storm Utility Drainage Piping."

B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a 6-inch (150-mm) course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of 12 inches (300 mm) of filter material, placed in compacted layers 6 inches (150 mm) thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 1557 with a minimum of two passes of a plate-type vibratory compactor.

C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches (300 mm) of final subgrade, in compacted layers 6 inches (150 mm) thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 1557 with a minimum of two passes of a plate-type vibratory compactor.

2. Place and compact impervious fill over drainage backfill in 6-inch- (150-mm-) thick compacted layers to final subgrade.

3.18 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.

2. Place base course material over subbase course under hot-mix asphalt pavement.

3. Shape subbase course and base course to required crown elevations and cross-slope grades.

4. Place subbase course and base course 6 inches (150 mm) or less in compacted thickness in a single layer.

5. Place subbase course and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.

6. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders, at least 12 inches (300 mm) wide, of satisfactory soil

materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.19 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.

2. Determine that fill material classification and maximum lift thickness comply with requirements.

3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.

B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. (186 sq. m) or less of paved area or building slab but in no case fewer than three tests.

2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet (30 m) or less of wall length but no fewer than two tests.

3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet (46 m) or less of trench length but no fewer than two tests.

F. 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 materials to 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 reestablish 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 directed by Architect; 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 greatest extent possible.

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove contaminated and polluted soils and legally dispose of them off Owner’s property.

B. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 31 20 00

PART 1 GENERAL

1.1 RELATED DOCUMENT

A. Drawings and general provisions of Contract, including General Supplementary Conditions, and Division 1 Specification sections, apply to this section.

1.2 SUMMARY

A. Provide all labor, materials, necessary equipment and services to complete the work called for in this Section or as shown on the plans, including but not necessarily limited to the following:

1. Excavating, backfilling and compacting for structures. (All excavations for this project will be considered as unclassified excavation).
2. Addition of processed aggregate base or borrow (if required), and disposal of unsuitable or excess materials.
3. Structural backfill under slabs on grade and against foundation walls.
4. Geotextile (filter fabric).
5. Any suggested recommendations identified in the Geotechnical Report.

B. Related Work: The following sections contain requirements that may apply to this section:

1. Division 3, Section "Cast-In-Place Concrete."

1.3 SUBMITTALS

A. Submit for review sieve analysis of off-site borrow and all different fills for review. Provide test reports of existing material to determine if suitable for reuse.

B. Product data for the following:

1. Filter Fabric.

C. Submit one modified proctor density test for each fill type in accordance with ASTM Method T-180.

1.4 QUALITY ASSURANCE

A. All work of this section shall be provided in accordance with the latest edition of State of Connecticut Department of Transportation Form 817 which is considered to be part of this specification, the same as if fully set forth herein.

1.5 DEFINITIONS

A. Excavation consists of removal of material encountered to subgrade elevations indicated and the reuse or subsequent disposal of excess materials removed. The classification for all excavations on this site shall be "unclassified" and shall include but not be limited to the removal of any and all earth, rock, and unsuitable material as required to construct the buildings and pavement to the lines and grades shown in the drawings at no additional cost to the Owner.

B. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Owner's Representative. Unauthorized excavation, as well as remedial work directed by Owner's Representative, shall be at Contractor's expense.

C. Additional Excavation: When excavation has reached required subgrade elevations, notify Owner's Representative, who will make an inspection of conditions. If the Owner's Representative determines that bearing materials at required subgrade elevations are unsuitable, continue excavation until suitable bearing materials are encountered and replace excavated material as directed by Owner's Representative.

D. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular subbase, drainage fill, or topsoil materials.

E. Borrow: Soil material obtained off-site when sufficient approved soil material is not available from excavations.

F. Subbase Course: The layer placed between the subgrade and the base course in a paving system or the layer placed between the subgrade and surface course of a walk.

Subbase Material: Gravel subbase material shall conform to the requirements of Section 2.12 of the Form 817. The minimum depth of subbase shall be as shown on the drawings and the contractor shall add additional processed aggregate base material as required.

G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground.

H. Unsuitable Materials: ASTM D 2487 Soil Classification Groups:

SC: Clayey sands, sand-clay mixtures.
ML: Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity.
CL: Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
OL: Organic silts and organic silty clays of low plasticity.
MH: Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
CH: Inorganic clays of high plasticity, fat clays.
OH: Organic clays of medium to high plasticity, organic silts.
Pt: Peat and other highly organic soils.
SM: Silt soils

1.6 PROTECTION

A. Underpin adjacent structures that may be damaged by excavation work, including service utilities and pipe chases.

B. Notify Owner's Representative of unexpected subsurface conditions and discontinue effected work in area until condition is resolved.

C. Protect bottom of excavations and soil adjacent to and beneath foundations against freezing when atmospheric temperature is less than 35°F.

D. 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.

E. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to sedimentation pools. Do not use trench excavations as temporary drainage ditches.

F. Grade top perimeter of excavation to prevent surface water runoff into excavation.

G. Use hay bales and silt fences for erosion protection and for preventing siltation of catch basins.

1.7 SPECIAL REQUIREMENTS

A. Before beginning work, the Contractor shall check, in the field, existing grades and layout as shown on the drawings and report any discrepancies that will affect the work of this contract to the Owner's Representative. Commencement of work will be implied to mean acceptance. No adjustments will be made for discrepancies discovered after work has begun.

B. The Contractor shall carefully protect all land monuments from disturbance or damage.

1.8 PROJECT CONDITIONS

A. Site Information: Data in subsurface investigation reports was used for the basis of the design and are available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings. The Owner will not be responsible for interpretations or conclusions drawn from this data by Contractor.

B. Contractor shall be responsible to contact Call Before You Dig (CBYD), telephone 1-800-922-4455, for information as to location of existing utilities and to obtain a permit number 48 hours before start of excavation.

1. 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.

2. Do not interrupt existing utilities serving facilities occupied by owner or others, during occupied hours, except when permitted in writing by Owner's Representative and then only after acceptable temporary utility services have been provided.

3. Provide the Owner's Representative a 48-hour minimum notice and wait to receive written approval to proceed before interrupting and utility.

C. Barricade open excavations occurring as part of this work and post with warning lights.

1. Operate warning lights as recommended by State authorities.

2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

PART 2 - PRODUCTS

2.1 MATERIALS

A. No on-site material may be used as controlled fill beneath the buildings or backfill for walls.

2.2 OFF-SITE MATERIALS

A. General: Provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations.

B. Common Fill - Borrow shall comply with Article 2.07.02 of the Form 817.

C. Granular Fill shall comply with Article M.02.01 of the Form 817. Use a maximum 3 in. size for fill placed within 12 in. of concrete slabs or foundations.

D. Crushed or processed stone shall conform to Form 817, Section M.02 for the size noted on the drawings and consist of sound, durable stone free of soft disintegrated pieces, mud, dirt, organic, or other injurious material.

E. STRUCTURAL BACKFILL FOR BUILDING: for footings and walls, controlled fill beneath slabs on grade and where indicated on the drawings shall conform to the following gradation:

Percent Passing	Sieve Size
100	3-1/2”
50-100	¾”
25-75	No. 4

The percent passing the No. 4 sieve shall have less than 15% passing the No. 200 sieve

F. THE 6” IMMEDIATELY BELOW SLAB ON GRADE: shall be ¾” minus processed stone conforming to the following gradation:

Percent Passing	Sieve Size
100	1.25”
90-100	1”
75-100	¾”
25-60	¼”
10-35	No. 40
3-12	No. 100
0-5	No. 200

The material shall be compacted in lifts not exceeding 12 inches to 95% of the modified Proctor density.

Refer to the Structural Drawings. If a conflict arises between the information in this specification and that shown on the drawings, the drawings shall be held.

G. Geotextile (Filter Fabric) shall conform to Section 7.55 of the Form 817 and shall meet the following minimum requirements:

minimum fabric weight of 16 oz./sy
minimum grab tensile strength of 425 lbs
minimum puncture resistance of 195 lbs

PART 3 - EXECUTION

3.1 GENERAL

A. Stockpile excavated materials acceptable for backfill and fill where directed on the drawings. Place, grade, and shape stockpiles for proper drainage. Place erosion controls as required.

B. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.

C. Dispose of excess excavated soil material and materials not acceptable for use as backfill or fill off-site in a legal manner at no expense to the Owner.

D. Excess material may be generated as a result of excavations and grading. All excess material shall be disposed of legally off-site at the Contractor's expense.

E. Site areas requiring new fill shall be stripped of all topsoil, organics, and soft yielding material prior to the depositing of fill material.

F. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding the project site and surrounding area. The Contractor shall not convey water to any area outside the project limits.

3.2 EXCAVATION

A. Before starting excavation, establish location and extent of any underground utilities occurring in work area.

B. Excavations shall be carried to a suitable undisturbed subbase. This subbase shall be free of any soft or yielding material.

C. All excavations shall be made to the proper elevations and dimensions indicated on the drawings with proper allowance made for structural fill and erection of forms. All excavation where shoring is required must comply with OSHA shoring provisions and campus safety policy.

D. Coordinate the excavation requirements here with information contained on Structural Drawing S1.3A.

3.3 INSTALLATION OF BACKFILL

A. Notify Owner’s Representative when excavations have reached required subgrade elevations. When the Owner’s Representative determines that unforeseen unsatisfactory soil is present as defined earlier, continue excavation and place with compacted granular fill material as directed.

B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Owner’s Representative at no additional cost to the Owner.

C. Procedures for placing granular fill and backfill shall conform to Form 817 Section 2.16. Granular fill and backfill shall be compacted to 95% modified proctor density as defined by ASTM D1557.

D. Subgrade beneath Granular fill should be compacted to 95% modified proctor density. Compact subgrade in accordance with Articles 2.09.03.

E. Fills and backfills where paved, or fills not otherwise specified, shall be compacted in 8" lifts to 95% modified proctor density.

F. All fill material shall be placed and compacted "in-the-dry.”

G. The Contractor shall not place a layer of compacted fill on snow, ice, or soil that was permitted to freeze prior to compacting. Removal of these unsatisfactory materials will be required as directed by the Owner.

H. Compacted fill shall not be placed when temperatures are below freezing.

I. Under footings, foundation bases or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete may be used to bring elevations to proper position, when acceptable to Owner's Representative.

J. Under structures, building slabs and steps compact top 12 inches of subgrade and each layer of backfill or fill material at 95 percent maximum density.

3.4 PLACEMENT OF GRANULAR AND STRUCTURAL FILL MATERIALS

A. Gravel and structural fill shall be a minimum of 12" deep and shall extend to undisturbed soil at all locations.

B. Installation shall be in layers no more than 8" deep for material compacted by 10-ton vibratory rollers and not more than 4" deep for material compacted by hand-operated tampers.

C. Material shall be compacted to a minimum of 95% optimum density as determined by the laboratory tests. All areas not meeting the required density shall be recompacted, at the Contractor's expense, until the required density is achieved.

D. Granular and structural fill shall be placed in the following locations:

1. Beneath slabs on grade within building area

2. Beneath exterior equipment slabs and entrance platforms

3. All other areas specifically noted on the drawings

E. When a compacted drainage course is indicated to be 8 inches thick or less, place material in a single layer. When indicated to be more than 8 inches thick, place material in less than 6 inches in thickness when compacted. Each layer shall be compacted to 95% of modified optimum density as achieved by AASHTO Method T180.

F. Gravel and structural fill shall be compacted at moisture content, which will allow proper compaction. Gravel and structural fill shall not be placed where standing water is present.

G. Gravel and structural fill shall be recompacted where disturbed by installation of pipes, conduits, etc. Compaction shall be performed so as not to damage the installed items. The excavation and recompaction described above is included in the Contract.

H. Grading Surface of Fill Under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation, provide final grades within a tolerance of 1/2 inch when tested with a 10-foot straightedge.

I. Protect all compacted gravel and structural fill from saturation with excess moisture and from freezing. Any material that loses its required density due to excess moisture or freezing shall be removed, replaced, and compacted at the Contractor's expense.

J. Do not backfill against foundation walls until walls have been adequately braced. Where backfill occurs on both sides of wall, keep levels of fill equal on each side at all times.

3.5 NOTIFICATION

A. When ledge rock or boulders are encountered, the material shall be uncovered and the Engineer notified. The Contractor shall be responsible for and provide the Engineer with cross sections

of the ledge rock surface. The Engineer shall be notified in advance as to when the cross section of ledge is to be made.

If the Contractor uncovers ledge, but fails to notify the Engineer, the Contractor shall have no right of claim to any classification other than that allowed by the Engineer.

B. The average end area method shall be used in the computation of volumes wherever practicable.

3.6 LIMITS OF EXCAVATION IN ROCK

A. Excavation in rock shall be performed, unless otherwise indicated on the Plans directed, so that no projection shall come within vertical planes 12 inches outside of the structure being built, 12 inches below the bottom of the structure base slab and footings, or as shown on the Drawings. Where excavation is carried beyond the above determined limits, the additional space shall be refilled at the Contractor's expense with concrete or other selected material, as directed by the Engineer.

3.7 ROCK REMOVAL

A. BLASTING WILL BE ALLOWED ON THIS PROJECT.

B. Removal of rock shall be to the limits as shown on the Contract Drawings. Over excavation beyond the limits shown shall not be paid for but shall be at the Contractor’s expense.

C. See Specification Section 31 23 16.26 ROCK REMOVAL for additional information.

3.8 DISPOSAL AND REPLACEMENT OF ROCK

A. Rock shall be considered unsuitable for backfilling and removed from the site.

B. Rock and boulders shall be replaced at no additional expense to the Owner with suitable material as specified above.

C. If rock below limits of excavation is caused by holes drilled too deep or any other circumstance due to excavation and if such shattered rock does not provided suitable foundation, the rock shall be removed and the excavation refilled with gravel at the expense of the Contractor. The gradation of gravel shall be as specified above.

3.9 TESTING

A. Field density tests will be performed by a qualified laboratory and paid for by the Owner.

B. The Contractor shall give the Owner’s Representative 24 hours notice when each layer of fill is in place and ready for testing so that the Owner’s Representative can observe field testing.

C. At the direction of the Owner’s Representative, all required re-testing (in case of failure) to meet specified density shall be at the Contractor's expense.

D. Compaction of fill materials shall conform to Section 2.02.03-6 State Specifications. Laboratory test to establish maximum density shall conform to AASHTO T-180 Method D, except that the molds used shall be 6.11" high. Field density tests shall be as specified by AASHTO T-191 or by use of a portable nuclear density testing device. Field density tests shall be taken at a depth equal to ½ the maximum depth of the lift tested. Compaction to 95% maximum density is required in all areas, except landscaped areas, where only 90% compaction is required. In areas receiving more than 3 feet of fill or backfill, each 3-foot portion of depth shall be tested separately. All areas receiving fill or backfill are subject to testing.

3.10 HAZARDOUS MATERIAL AND WASTE CONTROL

A. Excavation and disposal of contaminated, polluted, or "environmentally compromised" materials shall be conducted in conformance with the environmental and abatement specifications. The handling of contaminated, polluted, or "environmentally compromised" water to be discharged as a result of dewatering shall be performed in accordance with the environmental and abatement specifications.

END OF SECTION 31 23 16

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.

B. Geotechnical Study for Proposed New Building and included in Section 00 31 32.13 Subsurface Geotechnical Report.

1.2 SUMMARY

A. Work Included: Providing all mass and trench Rock Excavation including the complete removal of rock off-site, if encountered, as defined below, in areas of cut and fill, including trenches, foundations, structures and retaining walls. Provide compacted structural fill as required.

B. Provide a pre-blast survey of all adjacent properties.

C. Suitable rock materials may be crushed and re-used on site.

D. Related work described elsewhere

1. Division 1 “Allowances and Contract Considerations” for allowances and unit prices effecting work in this section.
2. Section 31 10 00 "Site Clearing" for site stripping, grubbing, stripping and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
3. Section 31 11 00 “Site Utility Preparation and Demolition” for removal, abandonment or protection of existing utilities.
4. Section 31 20 00 “Earth Moving” for excavation and filling for rough grading the site, and preparing subgrades.
5. Section 31 23 16 “Structural Excavation and Fill” for excavation and backfill of structures.
6. Section 31 23 19 "Dewatering" for lowering and disposing of ground water during construction.
7. Section 31 23 33 “Trenching and Backfilling” for excavating, backfilling and compacting for utilities.
8. Section 31 25 00 “Storm Water Pollution and Control Plan” for slope protection and erosion control devices.
9. Section 31 41 00 "Excavation Support" for support systems of structure, shoring, and trench excavations.

1.3 REFERENCE STANDARDS

A. Form 817 shall mean the State of Connecticut, Department of Transportation Standard Specifications for Roads, Bridges and Incidental Construction Form 817-2019 or its latest edition and any supplemental specifications.

1.4 ROCK DEFINITION

A. All boulders measuring 1.0 cu. yd. or more in volume, solid rock, ledge rock, or rock hard cementitious aggregate deposits or masonry structures that require blasting or the use of rippers to break it up, prior to its removal when encountered within the limits of excavation.

1.5 METHOD OF MEASUREMENT:

A. Rock Excavation shall be measured in cubic yards in its original position by the cross section method, except that where such measurement is impractical, the volume shall be measured by such methods as the Architect and Owner may determine. Boulders or materials which are to be included in this item shall be measured at the point of removal. Limits shall be only for excavation to the lines and grades described in this Specification and shown on the Drawings or as directed by the Architect and Owner. Disposal of material shall be included in the unit price bid for rock excavation.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Persons responsible for blasting shall be licensed blasters in the State of Connecticut and shall have had at least five years experience in similar excavations in rock and controlled blasting techniques.
2. Engage the services of a qualified, independent professional engineer, to conduct a pre-blast condition survey of adjacent structures.
3. Conduct blast monitoring by persons trained in the use of a seismograph; records shall be analyzed and results reported by persons familiar with a seismograph record.

B. Codes, Permits and Regulations:

1. Comply with applicable laws, rules, ordinances and regulations of the federal government, the State of Connecticut, governing the transportation storage, handling, and use of explosives. All labor, materials, equipment, and services necessary to make the blasting operations comply with such requirements shall be provided without additional cost to the Owner.
2. Obtain and pay for permits and licenses required to complete the work of this Section.
3. In case of conflict between regulations or between regulations and Specifications, comply with the strictest applicable codes, regulations or Specifications.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT: as selected by the Contractor.

PART 3 - EXECUTION

3.1 PROCEDURES

A. If rock is encountered, do not proceed with work until quantities are measured and agreed to with the Owner.

B. Rock shall be excavated to the lines and grades (depths) indicated on the plans.

3.2 BLASTING - GENERAL PRECAUTIONS

A. When: the use of explosives is necessary for the prosecution of the Work, the Contractor shall exercise the utmost care not to endanger life and property. Secure all applicable permits from local and State authorities. The Contractor shall be responsible for all damage resulting from the use of explosives. Blasting mats or other approved flyrock protection shall be employed for all blasting.

B. All Explosives: shall be stored in a secure manner in conformance with all federal, state and local laws and regulations. Such storage places shall be marked clearly "DANGEROUS - EXPLOSIVES". Storage, handling and use of explosives shall conform to the current regulations of the Connecticut Department of Public Safety and DOT Form 817-2016, Section 1.07.08, and as per other general State and City requirements. No overnight storage is allowed.

C. Give: at least 48 hours notice for each blasting operation and a schedule of blasting operations to the operating Fire Marshall official, the owner, the company or companies leasing, owning or responsible for pipes, conduits, poles, wires or any other public or private utilities which may be endangered by the blasting, in order that a representative of the said owner or lease may be present at the site.

D. Employ only experienced licensed blasters in the handling, loading and firing of the explosives.

E. Verify that blasting operations will not violate the boundaries of easements, property lines or rights-of-way.

F. Prior: to blasting, the Contractor's engineer , in the company of the Owner's Representative, shall perform a pre-blast survey inspecting neighboring structures and houses to determine any and all existing conditions, and supply a copy of the survey to Owner. Inspections shall include identifying existing foundation and wall cracks, broken windows, etc. as required. Any damage to surrounding structures, homes and the existing buildings to remain shall be repaired at the contractor's expense and at no additional cost to the Owner.

G. Approval of methods and procedures for initiating the work, as well as meeting the herein stated maximum peak particle velocity and over pressure requirements, will not relieve the Contractor of his responsibilities in connection with the work safety or direct or indirect damages to existing or new structures. All damage caused by Contractor's blasting operations shall be repaired to the full satisfaction of the Owner at no additional cost to the Owner.

H. The amount of vibration and overpressure generated by blasting shall not exceed regulatory statutes or directives established by State. In no case shall the peak particle velocity generated by blasting exceed 1" per second, as measured at the property line, nor shall overpressure be greater than 130 decibels. Additionally peak particle velocities experienced by freshly placed concrete shall be controlled to the following limits:

I.	Elapsed Time After Casting	Maximum Peak Particle Velocity
J.	0 to 2 hours	1 inch per second
K.	2 to 24 hours	0.5 inch per second
L.	24 to 72 hours	1 inch per second
M.	More than 72 hours	2 inches per second

N. Prior: to blasting, the Contractor shall place and/or install all required warning signs, sounding devices, lookouts, and guards to protect the safety of life and property.

O. The exposed rock face shall be inspected by the geotechnical engineer.

P. The Contractor shall presplit the rock along the proposed rock slopes to the lines and inclinations shown on the plans except as otherwise provided in the specifications. The presumptive slope angle for long term rock cuts can be 1H:6V. Presplitting will be required where the backslope is designed at an inclination one (vertical) on one (horizontal) or steeper or where the cut in rock is ten feet (3meters) or more, measured on the inclination of the proposed slope from the bottom of excavation to the natural surface of sound rock. The maximum vertical height of slope face which can be presplit at any one time shall be 50 feet (15 meters).

Q. The presplitting holes shall follow the required rock slope lines and inclinations. Hole drilling shall commence only when solid rock is encountered and exposed to the satisfaction of the Engineer. Unless otherwise permitted by the Engineer, presplitting holes shall have a spacing of 2 feet, center-to-center, and a diameter not greater than 3 inches (75 millimeters). The holes shall be extended from the top of solid rock surface to the toe of finished rock slope, unless lesser depths are specified on the plans. The proper angle of drilling shall be maintained at all times so all presplit holes lie essentially in the same plane and are paralleled to each other. No holes shall deviate more than 6 inches (150 millimeters) at any place in the plane of the specified slope line nor in its vertical alignment. If any cut is presplit by vertical stages (lifts), the presplit holes may be offset, for each stage, a distance not more than 24 inches (600 millimeters) inside the previously presplit face. Presplit holes shall be lightly loaded with a continuous column charge manufactured especially for presplitting. All space in each hole not occupied by the explosive charge shall be filled with clean stone chips less than 3/8 inch (9 millimeters) in size or approved equal. Charges near the top of hole shall be reduced sufficiently to eliminate overbreak and heaving. The top charge shall not be less than 3 feet (1 meter) below the top of the drill hole. The methods of detonation shall be such that a uniform plane of rupture of the rock occurs from top to bottom and between presplit holes. If necessary, the Contractor shall adjust the methods as outlined above so as to result in a uniform plane of rupture in the rock.

R. Unless otherwise approved by the Engineer, presplit holes shall be drilled at least 50 feet (15 meters) ahead of, and shall be detonated prior to the drilling and blasting, the general pattern holes within the section of any lift of rock to be excavated. The presplitting shall be performed so as to produce a uniform plane of rupture in the rock such that the resulting rock face will not be affected by subsequent blasting and excavation operations.

S. In the general pattern, blasting following presplitting operations, no portion of any blast hole shall be drilled closer than 4 feet (1.2 meters) to the presplit face. No portion of any blast hole larger than 3 inches (75 millimeters) in diameter shall be permitted closer than 12 feet (3.5 meters) to the presplit face. The spacing of blast holes, distribution and type of explosives, methods of detonation, and the blasting techniques shall be adjusted by the Contractor according to the characteristics and structure of the rock encountered so as not to fracture the rock beyond the presplit face.

T. There are secondary fractures in the rock. Areas with excessive secondary fracturing or an unfavorable dip orientation could be retained with rock reinforcement and a shot crete surface.

U. Prior to any blasting, the Owner's Representative will call a blasting conference at which the Contractor shall be represented to determine the methods to be used and the required protection to insure the utmost safety during blasting operations. The Contractor shall be responsible for all damage due either directly or indirectly to such operation. As part of his review of the Contractor's plan, the Owner's representative may designate an exploratory area of rock excavation to which the Contractor will confine his initial drilling and blasting operation. No additional drilling or blasting will be performed until the Owner's Representative's

examination of the blasting effects has been completed and the original plan of operations reaffirmed or revised in writing, based on the Owner's representative's review.

V. The Contractor shall schedule his operations so that all rock excavation within a distance of 100 feet (30 meters) of bridge or other large structures, or any portion thereof, is completed to the required slope lines and depths before any structure work is started.

W. All loose and unstable material, even if located beyond the payment lines, and all breakage and slices shall be removed as directed and as the excavation for each vertical stage (lift) progresses. It shall be, at all times, the responsibility of the Contractor to perform all phases of this work to produce the required rock slope faces to the satisfaction of the Engineer.

3.3 REMOVAL BY OTHER MEANS:

A. Where indicated on the plans or as ordered by the Engineer, rock shall be excavated without the use of explosives. Excavation methods by the use of drilling, splitting, wedging or other approved methods not involving the use of explosives shall be utilized. The method selected by the Contractor shall allow excavation to the slope line(s) and depth(s) as shown on the plans and shall not affect in any way the material or structures outside the excavation line or grade.

3.4 LIMITS OF EXCAVATION

A. Depth:

1. Tree Planting Areas: 4' below finish elevations shown on the Drawings.
2. Shrub Planting Areas: 24" below indicated finish grades.
3. Athletic Fields: 36" below indicated finish grades.
4. Pavements: Bottom elevations of the specified base or subbase course.
5. Structures and Footings: bottom elevation of the structure or footing, except as noted.
6. Pipe Trenches: bottom of bedding material

B. Horizontal:

1. Planting Areas: width of plant excavation plus 12" all around.
2. Lawn and Pavements: area of lawn plus 18" all sides .
3. Structures and Footings (includes pipe): dimension of structure, footing or pipe plus 12" each side.

C. No payment will be made for additional rock required to be removed to meet other excavation/trenching regulatory requirements.

3.5 REMOVAL: Rock not crushed as specified and used on site to be disposed of off site.

END OF SECTION 31 23 16

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PART 1 - GENERAL

1.1 SYSTEM PERFORMANCE REQUIREMENTS

A. Dewatering shall include all necessary control and disposal of groundwater on a 24-hour basis during construction.

B. Dewatering shall include the lowering of the groundwater table to relieve any hydrostatic head that could cause a decrease in the stability of the excavated subgrade. It shall also include the intercepting of seepage, which could otherwise emerge from the slope or sides of excavations, which could cause a decrease in the stability of the excavated subgrade or the slopes or sides of the excavations.

C. Dewatering shall be performed during construction to temporarily protect against the following:

1. The loss of any material beneath the excavated subgrade or from the slopes or sides of the excavations or the movement of any fine particle materials from the soil.

2. Any increased vertical or lateral loads on the excavation support systems.

3. Any disturbance, rupture, instability, boiling or heaving of the bottom of excavated subgrade during:

   a. Excavation.
   b. Placement of foundation or bedding materials.
   c. Construction of slabs, footings, pipes, conduits, underdrains and any other structures.
   d. Backfilling operations.

D. The Contractor is forbidden from discharging water collected from the dewatering operations directly into watercourses, wetlands areas, and storm drainage systems. As a result, the Contractor shall provide for methods, materials, and construction, to be approved by the Engineer and Owner, for collection and treatment of the dewatering operations discharge(s). At a minimum, these methods will include conveying the discharged water through a sedimentation system, appropriately sized for the operation, as described in Section 312500 and indicated on the drawings.

If, in the sole opinion of the Engineer, the sedimentation system is inadequate, the contractor shall be required to provide dual compartment septic tank, appropriately sized for the operation, to which the dewatering water shall be directed.

In no case will discharge containing visible sediment, or other pollutants be allowed to discharge to wetlands areas or drainage systems. The proposal for treating the dewatering discharge water shall be prepared by a Connecticut Registered Professional Engineer.

1.2 RELATED DOCUMENTS

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

B. 2002 Connecticut Erosion and Sedimentation Guidelines

C. All related specification sections shall be used in conjunction with this section.

D. CONN DOT Form 817.

1.3 ADDITIONAL PROVISIONS

A. Provide, operate, and maintain any dewatering system required to lower and control groundwater levels and groundwater hydrostatic pressure during the construction of the work, as required by this Section and the Contract Documents with no additional time allowed for the completion of the work.

B. Remove and dispose of water resulting from activities described in 1.1 C and 1.2 A and C above.

C. Remove dewatering systems and equipment when no longer required.

1. 4 SUBMITTALS

A. Submit under provisions of Division 1.

B. **DEWATERING PLAN:** The Contractor shall submit plans for the proposed dewatering system to the Engineer for review. Dewatering system shall be designed by a Professional Engineer licensed to practice in the State of Connecticut for the drainage area being directed to the dewatering system and submitted for review. Sizes and locations shown on the plans are minimums.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 GENERAL PRACTICES

A. The dewatering system shall be capable of developing an excavated subgrade relieved of any hydrostatic pressure that could cause a decrease in the stability of the excavated subgrade and which will provide the necessary groundwater control for the proper performance required for completion of the work.

B. The dewatering system shall not cause damage to newly constructed or existing properties, buildings, utilities and other work due to the loss of ground or support from incompletely drained soils or from removal of soil particles caused by the dewatering system.

C. Dewatering facilities shall be located only where they will not cause interference with work performed by others.

D. If the dewatering system utilized by the Contractor causes or threatens to cause damage to new or existing facilities, the dewatering system shall be removed and/or modified at no additional expense to the Owner.

E. Dispose of subsurface water collected in a manner that conforms to all applicable local and state ordinances, statutes and laws as well as Section 1.2 above.

F. Maintain continuous and complete effectiveness of the installation at all times.

G. Provide dewatering necessary to maintain the groundwater table a minimum of 2 feet below the

bottom of excavated subgrade or the prevailing level of backfill as it is being placed. The groundwater table shall also be maintained at a level, which will not result in uplift pressure in excess of 80% of the downward pressure produced by the weight of the structure and any backfill in place.

3.2 JOB CONDITIONS

A. Erosion Control: The Contractor shall provide adequate protection from erosion from any of the dewatering operations utilized during the course of the construction. Any damage, disruption, or interference to newly constructed work or existing properties, building, structure, utilities and/or other work resulting directly or indirectly from dewatering operations conducted under this Contract shall be remedied by the Contractor to the satisfaction of the Engineer, at no cost to the Owner.

B. Treatment of Dewatering Operations Discharges: It shall be the responsibility of the Contractor to provide such additional treatment as may be required to meet the provisions of the Contract. This may include the construction of sumps and/or settling basins, stone rip rap, silt fences or other the noted septic tankage requirements. They shall be provided and later removed and/or filled in with acceptable backfill material once they are no longer needed at no additional expense to the Owner.

3.3 HAZARDOUS MATERIAL AND WASTE CONTROL

A. Excavation and disposal of contaminated, polluted, or “environmentally compromised” materials shall be conducted in conformance with the environmental and abatement specifications. The handling of contaminated, polluted, or “environmentally compromised” water to be discharged as a result of dewatering shall be performed in accordance with the environmental and abatement specifications.

END OF SECTION 31 23 19

ISSUED for BID

PART 1 GENERAL

1.1 RELATED DOCUMENT

A. Drawings and general provisions of Contract, including General Supplementary Conditions, and Division 1 Specification sections, apply to this section.

1.2 SUMMARY

A. Provide all labor, materials, necessary equipment and services to complete the work called for in this Section or as shown on the plans, including but not necessarily limited to the following:

1. Excavating, backfilling and compacting for utilities. (All excavations for this project will be considered as unclassified excavation).
2. Addition of processed aggregate base or borrow (if required), and disposal of unsuitable or excess materials.
3. Granular fill for trench backfill.
4. Bank or crushed stone for use in utility trenches.
5. Blasting
6. Geotextile (filter fabric).
7. Any suggested recommendations identified in the Geotechnical Report.

B. Related Work: The following sections contain requirements that may apply to this section:

1. Division 31, Section "Site Utility Preparation and Demolition."
2. Division 31, Section "Structural Excavation and Fill"
3. Division 31. Section "Storm Water Pollution Control Plan (SWPCP)".

1.3 SUBMITTALS

A. Submit for review sieve analysis of off-site borrow and all different fills for review. Provide test reports of existing material to determine if suitable for reuse.

B. Submit one modified proctor density test for each fill type in accordance with ASTM Method T-180.

1.4 QUALITY ASSURANCE

A. All work of this section shall be provided in accordance with the latest edition of State of Connecticut Department of Transportation Form 817 which is considered to be part of this specification, the same as if fully set forth herein.

1.5 DEFINITIONS

A. Excavation consists of removal of material encountered to subgrade elevations indicated and the reuse or subsequent disposal of excess materials removed. The classification for all excavations on this site shall be "unclassified" and shall include but not be limited to the removal of any and all earth, rock, and unsuitable material as required to construct the buildings and pavement to the lines and grades shown in the drawings at no additional cost to the Owner.

B. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Owner's Representative. Unauthorized excavation, as well as remedial work directed by Owner's Representative, shall be at Contractor's expense.

C. Additional Excavation: When excavation has reached required subgrade elevations, notify Owner's Representative, who will make an inspection of conditions. If the Owner's Representative determines that bearing materials at required subgrade elevations are unsuitable, continue excavation until suitable bearing materials are encountered and replace excavated material as directed by Owner's Representative.

D. Subgrade: The undisturbed earth or the compacted soil layer immediately below granular subbase, drainage fill, or topsoil materials.

E. Borrow: Soil material obtained off-site when sufficient approved soil material is not available from excavations.

F. Subbase Course: The layer placed between the subgrade and the base course in a paving system or the layer placed between the subgrade and surface course of a walk.

G. Subbase Material: Gravel subbase material shall conform to the requirements of Section 2.12 of the Form 817. The minimum depth of subbase shall be as shown on the drawings and the contractor shall add additional processed aggregate base material as required.

H. Unsuitable Materials: ASTM D 2487 Soil Classification Groups:

SC Clayey sands, sand-clay mixtures.
ML Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity.
CL Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
OL Organic silts and organic silty clays of low plasticity.
MH Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
CH Inorganic clays of high plasticity, fat clays.
OH: Organic clays of medium to high plasticity, organic silts.
Pt Peat and other highly organic soils.
SM Silt soils

1.6 PROTECTION

A. Underpin adjacent structures that may be damaged by excavation work, including service utilities and pipe chases.

B. Notify Owner's Representative of unexpected subsurface conditions and discontinue effected work in area until condition is resolved.

C. Protect bottom of excavations and soil adjacent to and beneath foundations against freezing when atmospheric temperature is less than 35°F.

D. 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.

E. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey rain water and water removed from excavations to sedimentation pools. Do not use trench excavations as temporary drainage ditches.

F. Grade top perimeter of excavation to prevent surface water runoff into excavation.

G. Use hay bales and silt fences for erosion protection and for preventing siltation of catch basins.

1.7 SPECIAL REQUIREMENTS

A. Before beginning work, the Contractor shall check, in the field, existing grades and layout as shown on the drawings and report any discrepancies that will affect the work of this contract to the Owner's Representative. Commencement of work will be implied to mean acceptance. No adjustments will be made for discrepancies discovered after work has begun.

B. The Contractor shall carefully protect all land monuments from disturbance or damage.

1.8 PROJECT CONDITIONS

A. Site Information: Data in subsurface investigation reports was used for the basis of the design and are available to the Contractor for information only. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings. The Owner will not be responsible for interpretations or conclusions drawn from this data by Contractor.

B. Locate existing underground utilities in areas of excavation work. If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.

C. Contractor shall be responsible to contact Call Before You Dig (CBYD), telephone 811, for information as to location of existing utilities and to obtain a permit number 48 hours before start of excavation.

1. 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.

2. Do not interrupt existing utilities serving facilities occupied by owner or others, during occupied hours, except when permitted in writing by Owner's Representative and then only after acceptable temporary utility services have been provided.

3. Provide the Owner's Representative a 48-hour minimum notice and wait to receive written approval to proceed before interrupting and utility.

D. Barricade open excavations occurring as part of this work and post with warning lights.

1. Operate warning lights as recommended by State authorities.

2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

PART 2 - PRODUCTS

2.1 ON-SITE MATERIALS

A. Existing site materials can be used for the following applications if in conformance with the applicable Section of the Specifications. The Contractor shall mix, pulverize, and add additional material as required to utilize material at no additional cost to the Owner.

2.2 OFF-SITE MATERIALS

A. General: Provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations.

B. Common Fill - Borrow shall comply with Article 2.07.02 of the CONN DOT Form 817.

C. Granular Fill shall comply with Article M.02.01 of the CONN DOT Form 817. Use a maximum 3 in. size for fill placed within 12 in. of concrete slabs or foundations.

D. Trench backfill under pavements shall consist of compacted gravel subbase and compacted processed base to the depths as shown on the plans. Compacted gravel subbase shall conform to Form 817, Article M.02.01. Compacted processed base shall conform to Form 817, Section M.05.01.

E. Processed or crushed stone shall conform to CONN DOT Form 817, Section M.02 for the size noted on the drawings and consist of sound, durable stone free of soft disintegrated pieces, mud, dirt, organic, or other injurious material.

F. Free-Draining Material shall conform to CONN DOT Form 817, Section M.02.07.

G. Geotextile (Filter Fabric) shall conform to Section 7.55 of the CONN DOT Form 817 and shall meet the requirements shown in the 312000 “Earth Moving” specification, or the 321216 “Bituminous Asphalt Concrete Paving” specification if trench backfill is under pavement.

2.3 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility.

PART 3 - EXECUTION

3.1 GENERAL

A. Stockpile excavated materials acceptable for backfill and fill where directed on the drawings. Place, grade, and shape stockpiles for proper drainage. Place erosion controls as required.

B. Locate and retain soil materials away from edge of excavations. Do not store within drip line of trees indicated to remain.

C. Dispose of excess excavated soil material and materials not acceptable for use as backfill or fill off-site in a legal manner at no expense to the Owner.

D. Excess material may be generated as a result of excavations and grading. All excess material shall be disposed of legally off-site at the Contractor's expense.

E. Site areas requiring new fill shall be stripped of all topsoil, organics, and soft yielding material prior to the depositing of fill material.

F. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding the project site and surrounding area. The Contractor shall not convey water to any area outside the project limits.

3.2 TRENCH EXCAVATION AND BACKFILL

A. Trench excavation shall conform to Section 2.05.03 of the Form 817 Standard State Specifications.

B. Cut trenches sufficiently wide to enable installation of materials and to allow inspection. Slope banks to angle of repose or install shoring where needed.

C. Excavate trenches to depth indicated or required to establish indicated slope and invert elevations.

D. Unless otherwise shown, separate trenches for each utility shall be provided. Maintain ready access for fire-fighting apparatus.

E. Grading trench bottoms: The bottom of the trenches shall be graded evenly to insure uniform bearing for full length of all pipes. Excavate to at least 4" below the pipe. .

F. Place and compact bedding course on rock and other underlying bearing surfaces and to fill unauthorized excavations. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Hand trim for bell and spigot pipe joints.

G. Place and compact trench backfill in accordance with Article 6.51.03 of the Form 817. Coordinate backfilling with required utilities testing.

H. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

I. The Contractor shall keep trenches free from standing water at all times. All necessary well pointing and/or pumping shall be performed and maintained at the Contractor's expense.

3.3 NOTIFICATION

A. When ledge rock or boulders are encountered, the material shall be uncovered and the Engineer notified. The Contractor shall be responsible for and provide the Engineer with cross sections of the ledge rock surface. The Engineer shall be notified in advance as to when the cross section of ledge is to be made.

3.4 LIMITS OF EXCAVATION IN ROCK

A. Excavation in rock shall be performed, unless otherwise indicated on the Plans directed, so that no projection shall come within vertical planes 12 inches outside of the structure being built, 12 inches below the bottom of the structure base slab and footings, or as shown on the Drawings. In trenches, the rock shall be removed to the limits shown on the typical trench section. Where excavation is carried beyond the above determined limits, the additional space shall be refilled at the Contractor's expense with concrete or other selected material, as directed by the Engineer.

3.5 ROCK REMOVAL

A. BLASTING WILL BE ALLOWED ON THIS PROJECT.

B. Removal of rock shall be provided sufficiently to allow the proposed work to be installed as shown on the contract drawings.

3.6 DISPOSAL AND REPLACEMENT OF ROCK

A. Rock shall be considered unsuitable for backfilling and removed from the site.

B. Rock and boulders shall be replaced at no additional expense to the Owner with suitable material as specified above.

C. If rock below limits of excavation is caused by holes drilled too deep or any other circumstance due to excavation and if such shattered rock does not provided suitable foundation, the rock shall be removed and the excavation refilled with gravel at the expense of the Contractor. The gradation of gravel shall be as specified above.

3.7 TESTING

A. Field density tests will be performed by a qualified laboratory and paid for by the Owner.

B. The Contractor shall give the Owner's Representative 24 hours notice when each layer of fill is in place and ready for testing so that the Owner's Representative can observe field testing.

C. At the direction of the Owner's Representative, all required re-testing (in case of failure) to meet specified density shall be at the Contractor's expense.

D. Compaction of fill materials shall conform to Section 2.02.03-6 State Specifications. Laboratory test to establish maximum density shall conform to AASHTO T-180 Method D, except that the molds used shall be 6.11" high. Field density tests shall be as specified by AASHTO T-191 or by use of a portable nuclear density testing device. Field density tests shall be taken at a depth equal to ½ the maximum depth of the lift tested. Compaction to 95% maximum density is required in all areas, except landscaped areas, where only 90% compaction is required. In areas receiving more than 3 feet of fill or backfill, each 3-foot portion of depth shall be tested separately. All areas receiving fill or backfill are subject to testing.

3.8 HAZARDOUS MATERIAL AND WASTE CONTROL

A. Excavation and disposal of contaminated, polluted, or "environmentally compromised" materials shall be conducted in conformance with the environmental and abatement specifications. The handling of contaminated, polluted, or "environmentally compromised" water to be discharged as a result of dewatering shall be performed in accordance with the environmental and abatement specifications.

END OF SECTION 31 23 33

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Supplementary Conditions, and Division 1 Specification sections, apply to this section.

1.2 SUMMARY

A. Provide all labor, materials, necessary equipment and services to complete the work called for in this Section or as shown on the plans, including but not necessarily limited to the following:

1. Slope protection and erosion control devices and measures as shown on the Drawings, around material stockpiles, and where directed by the Engineer.
2. Maintenance, repair and replacement of slope protection and erosion control devices and measures as required. One employee of the General Contractor shall be assigned to inspect the erosion control measures and to maintain or repair them as necessary. Such maintenance and repair shall take precedence over other work.
3. Removal of slope protection and erosion control devices and measures when no longer required.
4. Construction of temporary perimeter stone swales, sediment forebays, dewatering basins, sediment basin, and outlet structures.
5. Temporary seeding or vegetative cover.
6. Installation of anti-tracking pad.
7. Removal of collected sediment and debris.
8. Restoration of disturbed areas to finish surface indicated on Drawings.
9. Installation of permanent mulches.
10. Conformance to erosion notes on plans and Connecticut DEP requirements.

B. Related Work: The following sections contain requirements that may apply to this section:

1. Division 31 Section ‘Site Clearing’
2. Division 31 Section ‘Earth Moving’
3. Division 32 Section ‘Turf and Grasses’

1.3 REFERENCE STANDARDS

A. Form 817, State of Connecticut Department of Transportation, Standard Specifications for Roads, Bridges, and Incidental Construction, 2016.

B. Connecticut Guidelines for Soil Erosion and Sediment Control, the Connecticut Council on Soil and Water Conservation, 2002.

C. Connecticut Stormwater Quality Manual, 2004.

D. Connecticut Department of Transportation Drainage Manual, 2000.

1.4 SEQUENCING/SCHEDULING

A. Install all soil erosion and sediment control devices and measures prior to commencing construction. Install additional measures as required during construction and maintain such structures throughout construction period.

1.5 SUBMITTALS

A. Submit under provisions of Division 1.

B. The Contractor shall submit a detailed Erosion and Sedimentation Control Plan prepared by a Professional Engineer licensed to practice in the State of Connecticut to the Owner, and Engineer for review. The Plan shall include specific measures related to the Contractor's means and methods for carrying out the proposed work. The Plan shall note the sequence of construction and any phasing of the work. Erosion and sedimentation control measures shown on the drawings are the very minimum which may be required. The Contractor is responsible for any additional measures that are necessary to stabilize the site and/or a result of site work phasing.

C. Submit a dewatering plan that will ensure protection of wetland areas and particularly the storm drainage system. Prior to the start of any work, this plan must be approved by the Engineer and the Owner.

D. Jute Mesh, Netting, Erosion Control Blanket or Matting and Filter Fabric: 12" x 12" sample with manufacturing data and instruction for installation.

E. Shredded Bark Mulch: 1 gallon showing range of size, tree material, and name and address of supplier.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hay Bales.

1. Hay bales shall consist of hay from acceptable grasses and legumes, free from weeds, reeds, twigs, chaff, debris, other objectionable material, or excessive amounts of seeds and grain. Hay shall be free from rot or mold and the moisture content shall not exceed fifteen (15) percent by weight at the time of weighing.

2. The hay shall be securely baled with wire of adequate size to allow for possible rusting while in use and to permit rehandling when the bale is in a saturated condition.

3. Individual bales shall be of a longitudinal shape not exceeding one hundred (100) pounds when weighed.

B. Stakes for Silt Fence: Hardwood or metal. Posts shall be of wood or steel and a minimum of 3.5 feet long. Wood posts shall be nominal 1 x 1 inches. Steel posts shall be round or U, T or C-shaped with a minimum weight of 1.3 pounds per foot, and have projections for fastening the wire to the fence.

C. Silt Fence Fabric:

1. Filter fabric for silt fence shall consist of pervious sheets of woven propylene, nylon, polyester, or ethylene yarn. Filter fabric material shall be on the ConnDOT approved material list and shall meet the following requirements.

PHYSICAL REQUIREMENTS FOR FABRIC SILT FENCE

Property	Test Method	Requirement
Grab Strength	ASTM D-4632-86	100 lbs.
Grab Elongation	ASTM D-4632-86	30% maximum
Trapezoid Tear Strength	ASTM D-4632-86	65 lbs.
Mullen Burst Strength	ASTM D-3786-80a	200 psi
Coefficient of Permeability k	ASTM D-4491-85	0.01 cm/sec.
Ultraviolet Stability	ASTM D-4355-84	90%

The filter fabric shall contain a stabilizer and/or inhibitors to make the filaments resistant to deterioration resulting from exposure to sunlight or heat to provide a minimum of 6 months of expected usable construction life at a temperature range of 0 to 120 degrees F. The filter fabric shall be a minimum of 36 inches wide, cut from a continuous roll to finish fence length to avoid the use of seams. Splice filter fabric together only when absolutely necessary and only at a support post, with a minimum 6-inch overlap and securely sealed. The filter fabric shall be free of defects or flaws which significantly affect its physical and/or filtering properties.

D. Wire Backing:

1. Wire for backing reinforcement shall be a minimum of 14.5 gauge with maximum mesh spacing of 6 inches.

2. Minimum height shall be 42 inches.

3. Wire staples for attaching filter fabric to wooden posts shall be No. 9 gauge and shall be at least 1 inch long.

E. Filter Fabric shall conform to requirements of M.08.01-26 of Form 817.

F. Jute Mesh and Anchoring Devices: Conform to requirements of M.13.06 of Form 817.

G. Erosion Control Blanket shall conform to Section M.13.09 of the Form 817. Erosion control matting shall be on the CT DOT Qualified Product List for erosion control materials and meet the following requirements:

Slopes 3h:1v to 2.1h:1v or as noted on the drawings:
minimum fabric weight of 8.5 oz./sy
100% straw fiber matrix
Biodegradable natural organic or photodegradable fiber netting (top and bottom)

1. Staple/fastener length should be 12” to assure that it meets compacted soil. Refer to the drawing details for the correct staple pattern for each blanket application type.

H. Shredded Bark Mulch:

1. Air-dried, pine or hardwood bark shredded to a size ranging from 1/4 inch to 2 inches.
2. Free from rot, leaves, twigs, shavings, coarse material, debris, and any other materials injurious to plant growth.

I. Hay Mulch:

1. Obtain from acceptable grass or legume mowings, free from weeds, course matter, or other objectionable material.
2. Free from rot or mould with moisture content of not more than 15 percent when delivered to project.

J. Netting: Approved material suitable for holding hay mulch in close contact with ground.

K. Mulch Binders:

1. Asphalt: Approved product manufactured for this purpose.
2. Synthetic: Approved product manufactured for this purpose.

L. Crushed stone for construction entrance and stone berms: 2 inch diameter conforming to M.02.01-2 of Form 817.

M. Temporary Seeding: Temporary seeding shall be placed if the contractor anticipates leaving exposed areas over the winter months.

N. Silt sack shall consist of filter fabric (see below), lifting straps, and containment area.

1. Filter fabric for silt sack shall consist of pervious sheets of woven monofilament fabric. Filter fabric material shall meet the following requirements.

PHYSICAL REQUIREMENTS FOR SILT SACK FABRIC

Property	Test Method	Requirement
Grab Strength	ASTM D-4632-86	200 lbs.
Grab Elongation	ASTM D-4632-86	24x10
Trapezoid Tear Strength	ASTM D-4632-86	75 lbs.
Mullen Burst Strength	ASTM D-3786-80a	450 psi
Coefficient of Permeability k	ASTM D-4491-85	0.14 cm/sec.
Ultraviolet Stability	ASTM D-4355-84	70%

PART 3 - EXECUTION

3.1 GENERAL

A. The Contractor shall plan and execute all operations, particularly those associated with excavation and backfilling, in such a manner as to minimize the amount of excavated and exposed fill or other foreign material that is washed or otherwise carried into wetlands and waterways.

B. The Contractor shall furnish and place hay bales, silt fencing, and other materials necessary for sedimentation and erosion control for streams and wetlands.

C. In the event the sedimentation or siltation prevention measures used by the Contractor prove to be inadequate as determined by the Engineer, the Contractor shall be required to adjust his operations to the extent necessary to prevent any such sedimentation or siltation from occurring.

D. The Contractor shall keep streams, brooks, and other water crossings clear of mud, silt, debris and other objectionable materials resulting from his construction operations.

1. The Contractor shall maintain flow capacity of river and stream channels to prevent unnatural flooding due to the Contractor's operations.

E. The Contractor shall use temporary vegetation, soil stabilization matting, and mulching to protect areas exposed during construction. He shall minimize the amount of bare earth exposed at any one time during construction, and he shall also minimize the length of time bare earth is exposed.

Excavated material to be stockpiled for reuse shall be stored away from brooks, streams, and wetland areas to prevent the washing of same back into the resource area.

F. Baled hay shall be placed to form temporary water stops, dams, diversions, dikes, berms and for other uses connected with water pollution control. Should any bales become too clogged to be effective, they shall be removed from the site and new hay bales provided as directed by the Engineer. Bales shall be replaced as often as necessary to provide effective sediment control.

Following completion of construction activities in a particular area, bales shall be legally disposed of, by the Contractor, off-site in an environmentally sound manner.

G. On sloping terrain, hay bales may be used to trap sediment until vegetation has become established. The details of their placement shall be as approved by the Engineer.

H. Sediment laden water that is being pumped from the trenches or excavations shall not be pumped directly into water courses. Sedimentation basins of filter fabric, wire fencing and hay bales or other means acceptable to the Engineer shall be used for this purpose.

1. If, in the sole opinion of the Engineer, the sedimentation system is not sufficient, the contractor shall be required to provide gross particle separator(s) upstream of the pump discharge areas. These separators may consist of dual compartment septic tanks, with inlet and outlet baffles. The outlet from the tank shall discharge into the sedimentation basins described above.

I. Spoil resulting from the trench excavation shall be leveled or removed to permit entry of water from adjacent land surfaces without excessive erosion or harmful ponding.

J. The silt fence shall be maintained at no additional cost to the Owner as follows: Inspect silt fences and filter barriers immediately before and after each rainfall and at least daily during prolonged rainfall. Provide any required repairs immediately. Should the fabric on a fabric silt fence decompose or become ineffective prior to the end of the expected usable life and the barrier still be necessary, replace the fabric promptly.

Remove sediment deposits after each storm event as directed by the Engineer. As a minimum, remove sediment when deposits reach approximately one-half the height of the barrier. Dispose of sediment deposits off-site, placed upland in a manner which will prevent its later erosion into the resource area, or in a manner approved by the Engineer.

Maintain the fabric silt fence until all upslope soils are permanently stabilized by vegetation.

3.2 HAY BALE CHECKS AND BARRIERS

A. Place hay bale checks and barriers where indicated on Drawings.

B. Excavate soil to form shallow trench, place, and firmly stake bales. Wedge loose hay between bales. Backfill and compact excavated soil against hay bales.

C. Conform to installation details indicated on Drawings.

D. Maintenance

1. Inspect checks and barriers periodically and after each storm.
2. Remove accumulated sediment periodically and when directed by Engineer.
3. Repair any damage immediately.

E. Removal and clean-up

1. Remove checks and barriers when no longer required or when directed by Engineer.
2. Restore disturbed areas to finish surface indicated on Drawings.

3.3 SILT FENCE

A. Place silt fence where indicated on the Drawings.

B. Firmly set stakes and attach wire backing and filter fabric as indicated on Drawings.

C. Maintenance

1. Inspect checks and barriers periodically and after each storm.
2. Remove accumulated sediment periodically and when directed by Engineer.
3. Repair any damage immediately.

D. Removal and clean-up

1. Remove checks and barriers when no longer required or when directed by Engineer.
2. Restore disturbed areas to finish surface indicated on Drawings.

3.4 JUTE MESH

A. Place jute mesh where indicated on Drawings immediately after surface upon which it is to be placed has been finished as specified under other sections of these specifications.

B. Conform to installation methods indicated on Drawings and described in 9.48.03 of Form 817.

C. Maintenance

1. Inspect checks and barriers periodically and after each storm.
2. Remove accumulated sediment periodically and when directed by Engineer.

3. Repair and damage immediately.

D. Removal and clean-up

1. Remove checks and barriers when no longer required or when directed by Engineer.
2. Restore disturbed areas to finish surface indicated on Drawings.

3.5 EROSION CONTROL BLANKET

A. Refer to the manufacturer's installation instructions for all applications and types of erosion control blankets.

B. Refer to the drawing details for blanket and staple installation instructions and information.

3.6 HAY MULCH

A. Spread mulch immediately following seeding operations.

B. Mulch shall be uniformly spread by hand or machine at a rate of approximately 2 tons per acre.

C. Apply mulch to obtain a uniform depth without matted spots.

D. Stabilize mulch immediately after mulch is spread with netting, asphalt, or synthetic tacking material.

E. Conform to manufacturer's instructions and obtain firm, continuous contact between mulch and soil.

F. Maintenance

1. Repair and replace areas which have been damaged.

G. Removal and Clean-up

1. Remove checks and barriers when no longer required or when directed by Engineer.
2. Restore disturbed areas to finish surface indicated on Drawings.

3.7 SHREDDED BARK MULCH

A. Spread mulch immediately following finish grading and planting.

B. Apply mulch to obtain a uniform depth of 3 inches. Remove large pieces and debris.

C. Repair and replace mulch as required to protect underlying soil.

3.8 STONE BERMS AND SWALES

A. Place stone to form berms around catch basins in areas to be paved prior to placement of pavement at locations as indicated on the Drawings.

B. Conform to dimensions indicated on the Drawings.

C. Repair and replace stone berms as required to protect catch basins and pipes.

D. Construct stone swales around perimeter of excavation. Swale shall maintain a positive pitch to temporary sediment basin. Swales and sediment basin shall be cleaned as required to maintain function.

3.9 CONSTRUCTION ENTRANCE

A. Install temporary construction entrance consisting of 2 inch crushed stone placed to the depth and area indicated on the Drawings.

B. Remove stone when no longer required. Restore subgrade and finish to grades with materials indicated on the Drawings.

3.10 FILTER FABRIC AND SILT SACKS AT CATCH BASINS

A. Place filter fabric and/or silt sack under grate at each catch basin in areas to be paved immediately after catch basin installation at locations indicated on the Drawings.

B. Clean and replace filter fabric and silt sacks as required to protect catch basins and pipes.

3.11 PROTECTION OF AIR RESOURCES

A. During the progress of work, the Contractor shall conduct his operations and maintain the area of his activities, including sweeping and sprinkling of water as necessary, so as to minimize the creation and dispersion of dust. If the Engineer decides that it is necessary to use calcium chloride for more effective dust control then the Contractor shall furnish and apply the material as directed.

B. Calcium chloride shall be commercial grade, furnished in 100-pound, 5-ply bags, stored under weatherproof cover and stacked alternately for ventilation. Application for dust control shall be at the rate of about 1/2 pound per square yard per application, unless otherwise directed by the Engineer.

C. Burning of rubbish and waste material on the site shall not be permitted.

D. Construction equipment shall be equipped with properly operating emission control devices and mufflers. Equipment not utilizing said devices shall be removed immediately from the site.

3.12 HAZARDOUS MATERIAL AND WASTE CONTROL

A. Disposal of volatile fluid wastes (such as mineral spirits, waste oil, gasoline, or paint thinner) in storm or sanitary sewer systems or into streams or waterways shall not be permitted.

In the event that any such waste is spilled onto the ground, the Contractor shall immediately notify the Engineer, promptly clean up the spillage and all contaminated soil, and dispose of the cleanings as hazardous waste material. If a spill occurs, the clean-up activities shall take precedence over normal construction activities in order that damage to the environment is minimized.

B. Fuels, lubricants or other hazardous materials shall not be stored in any resource areas.

C. Fuel, lubricants and other hazardous materials shall be stockpiled within an area of positive containment. The area shall have no open communication with surface water bodies or other resource areas, shall have a base of relatively impermeable material and shall have an adequate supply of materials required for spill clean up.

D. All hazardous materials containers shall be properly marked and their contents identified. All fuel oil, lubricant, gasoline, and hydraulic fluid containers shall be fixed in place on the transport vehicle when the vehicle is in motion.

E. The construction project shall be in compliance with all Federal, State, and local laws with respect to hazardous materials.

F. All clean up and disposal operations shall comply with all applicable Federal, State, and local statutes, regulations and ordinances and anti-pollution laws.

G. Excavation and disposal of contaminated, polluted, or "environmentally compromised" materials shall be conducted in conformance with the environmental and abatement specifications. The handling of contaminated, polluted, or "environmentally compromised" water to be discharged as a result of dewatering shall be performed in accordance with the environmental and abatement specifications.

3.13 NOISE ABATEMENT

A. Construction equipment including generator and compressors shall be enclosed or equipped with mufflers, silencers or other equipment to minimize noise.

B. The Contractor shall limit construction noise in accordance with EPA latest standard criteria.

3.14 PERMITS

A. The Contractor shall comply with all requirements of all applicable Federal, State, and local regulations and all permits issued for the Contract.

B. General Permit Registration or the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities, for disturbed areas greater than 1 acre.

1. Assume responsibility for storm water pollution control by submitting to the Connecticut Department of Energy and Environmental Protection (DEEP) a "General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities" registration; conform to the permit requirements.

2. Conform to the Erosion and Sediment Control Plan included in the Contract Documents or use another plan, prepared at the Contractor's expense by a Professional Engineer, licensed by the State of Connecticut, which has been approved by the Owner and the Connecticut Department of Energy and Environmental Protection.

4. Sign and cause to be signed by each appropriate subcontractor, the Certification Statement required by the General Permit.

5. Provide, maintain, and monitor a rain gauge on the site; monitoring shall include maintaining a log of the readings. The rain gauge shall remain the property of the Contractor.

6. Inspect all erosion controls measures on a weekly basis and after each rainfall event. Record corrective measures and repairs that are required, when they were performed and who made the corrections/repairs.

END OF SECTION 31 25 00

ISSUED for BID

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Installation, maintenance, and removal of excavation support systems including the following:

1. Structure excavation.
2. Shoring excavation.
3. Trench excavation.

1.2 RELATED DOCUMENTS

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

B. All related Specification Sections shall be used in conjunction with this Section.

1.3 SUBMITTALS

A. Provide services of registered Structural Engineer to design bracing, shoring, and/or underpinning if this work is required. Submit Engineer's design for record purposes.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials shall include support members such as soldier piles, lagging, sheet piles, and other bracing members such as walers, struts, shores, and tieback anchors.

PART 3 - EXECUTION

3.1 EXCAVATION SUPPORT

A. The Contractor shall be totally responsible for the means and methods of excavation and for the design and construction of the excavation support system.

B. All excavation support systems shall be constructed so as to be able to support all vertical and lateral loads and other surcharge loads imposed on the system during construction including earth pressures, utility loads and other surcharge loads in order to provide safe and expeditious construction of the permanent structures and prevent movement and/or damage to adjacent soil, buildings, structures and utilities.

C. The support system shall be designed to support the maximum loads that will occur during construction.

D. The Contractor shall not perform excavations in running ground and must employ a positive means of containing material behind support walls before excavation is allowed to proceed.

E. The Contractor shall monitor all excavations to accurately provide a means of determining movement of adjacent soil, buildings, structures, and utilities.

F. When movement or damage is observed, the Contractor shall immediately cease excavation operations and correct such deficiencies in the excavation support system that have allowed for movement or damage and repair any and all damage that has resulted.

G. The Contractor shall be responsible for and repair any and all damage resulting from his excavations at no additional cost to the Owner and at no additional time for performance.

3.2 ADJACENT STRUCTURES

A. Protect Adjacent Structures: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of adjacent structures.

1. Strengthen or add new supports as required during progress of the work.

END OF SECTION 31 41 00

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Bituminous paving for parking lots and roadways and associated preparatory work.

B. Aggregate base course.

C. Gravel and Crushed Stone subbase.

1.2 RELATED DOCUMENTS

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

B. All related specification sections shall be used in conjunction with this section.

1. Section 31 23 33; “Trenching and Backfill”

1.3 REFERENCE STANDARDS

A. The State of Connecticut Department of Transportation Standard Specifications for Road and Bridge Construction (Form 816 and Form 817).

1.4 SUBMITTALS

A. Submit under provisions of Division 1.

B. Letter of compliance shall be furnished by the Contractor to the Engineer prior to the placing of material listed under this Item.

C. Mix/batch design shall be submitted for each type of bituminous asphalt concrete to be placed.

D. Material certificate for tack coat.

E. Geotextile product data with 12 by 12 inch sample for verification.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Subbase

1. Lower Fields (applies for Gravel Parking Areas as well):

a. Subbase material shall conform to the requirements of Article M.02.06 Grade A, CONN DOT FORM 817 for Bank Gravel and Crushed Stone unless indicated otherwise on the drawings.

2. Upper Fields:

a. Subbase material shall conform to the requirements of Article M.02.06 Grade A, CONN DOT FORM 817.

B. Processed Aggregate Base

1. Lower Fields (applies for Gravel Parking Areas as well):

a. 3/4" Minus Processed Base material shall conform to the following gradation:

Percent Passing	Sieve Size
100	1.25"
90-100	1"
75-100	¾"
10-35	¼"
3-12	No. 100
0-5	No. 200

2. Upper Fields:

a. Stone Aggregate Base material shall conform to the requirements of Article M.05.01, CONN DOT FORM 817.

C. Bituminous Materials

1. Bituminous concrete, tack coat, joint sealer, etc. for roads shall conform to the requirements of Section M.04, CONN DOT FORM 816 and meet the thickness specified on drawings.

a. Surface course of pavement mixture shall be Class 2, as defined in ConnDOT M.04.03.

b. Binder course of pavement shall be Class 1, as defined in ConnDOT M.04.03.

2. Bituminous concrete for walks shall conform to the requirements of Section M.04, CONN DOT FORM 816.

a. Surface course of pavement mixture shall be Class 2, as defined in ConnDOT M.04.03.

D. Temporary Steel Plates

1. Temporary steel plates for temporary trench covers shall be suitable to withstand traffic loading, including AASHTO H20 loads. Plates shall also conform to additional requirements as indicated on the traffic control plans. Steel plates shall not be left in place for more than 12 hours. All trenches must be backfilled prior to holidays, weekends, and other extended suspensions of the work.

E. Material for Tack Coat

1. Tack coat shall be emulsified asphalt conforming to Section M.05 of Form 817.

F. Separation Geotextile: Woven geotextile filter fabric shall conform to Section 7.55 of the CONN DOT Form 817 and shall be one of the following or an approved equal:

Mirafi RS380i
Propex Geosolutions GEOTEX 315ST
Carthage Mills FX-66

PART 3 - EXECUTION

3.1 GENERAL

A. Areas to receive bituminous paving shall be as shown on the Drawings or as specified herein.

B. Pavement restoration shall be as shown on the Drawings or as specified herein.

3.2 EXECUTION

A. In areas where trenching was conducted, the Contractor shall allow a 30-day settling period to transpire before placing permanent pavement, or as determined by the Engineer.

B. Edges of pavement removed during trenching or other excavations shall be sawcut to provide one-foot minimum overlap of the final patch on undisturbed material.

C. Base course shall be constructed in the areas and to the depths shown on the Drawings and in accordance with CONNDOT Specifications, except as herein modified.

1. Gravel base and processed gravel base courses shall be placed in maximum 6-inch lifts compacted to 95% maximum density, unless otherwise directed by the Engineer.
2. Gravel shall be fine graded with a power grader or other approved equipment. Tolerance shall be within 1/2" or less.
3. No pavement shall be placed until fine grading has been checked and reviewed by the Engineer.

D. Bituminous wearing and base courses shall be constructed as per CONNDOT Specifications, except as herein modified.

1. Pavement shall only be placed when the underlying surface is dry, frost-free and the surface temperature is above 50°F, unless otherwise directed by the Engineer.
2. Pavement shall only be placed during daylight hours.
3. Material delivered to the paver shall not have a temperature lower than 250°F.
4. All catch basins shall be covered with an acceptable cover before the paver passes over the grate.
5. Manholes and other castings shall be sprayed with kerosene or other product before the paver passes over the casting. The casting shall be clean of asphalt at the completion of the paving.
6. Extreme care shall be used around catch basins. The Contractor shall do the necessary handwork to provide a downward slope into the grate.
7. Compaction shall be performed by an 8-ton minimum static steel wheel roller followed by a pneumatic-tired roller.
8. The wearing course shall be rolled until all roller marks are eliminated.

END OF SECTION 32 12 16

ISSUED for BID

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. Reinforced concrete pavements for walkways and exterior slabs for equipment including expansion joint materials and sealants.
2. Detectable Warning Square Cast Iron Paver
3. Two-Component stair nosing systems for cast in place concrete site stairs.
4. Water repellant and chloride screen.

B. Related Requirements:

1. Section 03 21 00 “Concrete Reinforcing” for reinforcing materials of concrete pavements.
2. Section 03 30 00 "Cast-in-Place Concrete" for general building applications of concrete.
3. Section 32 16 13 “Precast Concrete Curbing” for precast concrete curb.
4. Division 1 Section 01 78 30 – “Warranties and Bonds” for warranty requirements applicable to the work of this Section.

1.3 REFERENCE STANDARDS

A. Form 817-2019 shall mean the State of Connecticut, Department of Transportation Standard Specifications for Roads, Bridges and Incidental Construction Form 817-2019 or its latest edition and any supplemental specifications.

1.4 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

B. Retain first subparagraph below if additional requirements are necessary; include information about conference.

C. Review methods and procedures related to concrete paving, including but not limited to, the following:

1. Concrete mixture design.
2. Quality control of concrete materials and concrete paving construction practices.

D. Require representatives of each entity directly concerned with concrete paving to attend, including the following:

1. Contractor's superintendent.
2. Concrete paving subcontractor.

1.6 SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.

C. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

D. Connecticut High Performance Building Submittals:

1. Recycled content materials.
2. Local materials.

E. Qualification Data: For qualified ready-mix concrete manufacturer.

F. Material Certificates: For the following, from manufacturer:

1. Cementitious materials.
2. Steel reinforcement and reinforcement accessories.
3. Admixtures.
4. Curing compounds.
5. Applied finish materials.
6. Bonding agent or epoxy adhesive.
7. Joint fillers.

G. Material Test Reports: For each of the following:

1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

H. Field quality-control reports.

1.7 QUALITY ASSURANCE

A. Ready-Mix-Concrete 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" (Quality Control Manual - Section 3, "Plant Certification Checklist").

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than 96 inches (2400 mm) by 96 inches (2400 mm).
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of 100 feet (30.5 m) or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT

A. Comply with Section 03 21 00 “Concrete Reinforcing”.

B. Joint Dowel Bars: cut to length of eight inches or twelve inches as indicated in the Drawings. Space at 16” on center, unless indicated otherwise on the Drawings.

C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Conform to the requirements of Form 817, Section 6.01 and M.03.01, Class ‘F’ and ASTM C-94. Batch mixing at site not acceptable.

1. Portland Cement: ASTM C 150, gray portland cement Type II.

B. Normal-Weight Aggregates: ASTM C 33,, uniformly graded. Provide aggregates from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 3/4 inch (19 mm) nominal.

2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: Potable and complying with ASTM C 94/C 94M.

D. Air-Entraining Admixture: ASTM C 260.

E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry or cotton mats.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.5 RELATED MATERIALS

A. Joint Fillers: ASTM D 1751, asphalt-saturated cellulosic fiber in preformed strips.

1. Thickness: ¼ inch, or as detailed.

2. Depth: to match concrete section.

B. Joint Sealant: Two component polyurethane elastomeric type complying with FS-TT-S-00227, self-leveling designed for foot traffic, as manufactured by SIKA, Pecora. Subject to compliance with requirements, provide the specified product or comparable product of BASF MasterSeal NP2 Sealant or LymTal International Iso-Flex 881 R Sealant.

1. Color to be selected by Landscape Architect.

C. Sealant Backer Rod: Compressible rod stock or polyethylene foam, polyethylene jacketed, butyl rubber foam, or neoprene foam, as recommended by sealant manufacturer where required for back-up of sealant.

D. Grout: Non-shrink, non-staining grout. Conform to CTDOT Form 817, Article M.03.05.

E. Water repellant and chloride screen: Consolideck Saltguard WB, water based salt guard densifier, silane/siloxane water repellant and chloride screen as manufactured by Prosoco. Subject to compliance with requirements, provide the specified product or comparable product of Foundation Armor SX5000 WB or Ghostshield Siloxa-Tek 8500.

2.6 DETECTABLE WARNING SQUARE CAST IRON PAVER MATERIALS

A. Detectable Warning Square Cast Iron Paver: 24 Inch x 24 inch paver.

1. Straight and radial detectable square cast iron paver warning plates shall be ADA II/ ABA compliant, with slip resistant surface.

2. Plate shall be heavy duty gray iron, compliant with ASTM A48 CL35B.

3. 24 inch width of tactile warning strip for dimensioned lengths, unless otherwise indicated on plans.

4. Provide radius sections as required to meet back of curb radii in project drawings.

5. Detectable Warning paver shall be manufactured with integral anchor lugs to ensure solid attachment to cast-in-place concrete.

a. Coating shall be undipped Grey iron with rust conditioner.

2.7 TWO-COMPONENT STAIR NOSING SYSTEMS

A. Basis-of-Design Product: subject to compliance with requirements, provide product indicated on drawings, Model DST-330 Two-component Stair Nosing by Balco Inc, 2626 S. Sheridan, PO Box 17249, Wichita, Kansas, 67217 (316) 945-9328. Subject to compliance with requirements, provide the specified product or comparable product of American Safety Tread or Nystrom Inc.

B. Stair nosing system:

1. Aluminum: ASTM B 221, alloy 6063-T5 for extrusions.

2. Cast Aluminum: Cast Aluminum alloy 319, tread plate.

C. Abrasive:

1. Standard Abrasive: Two (2) part Epoxy combined with aluminum oxide grit standard.

D. Fasteners required for complete installation to manufacturer's instructions:

1. Two Component Stair Nosings: Standard and Tread plate securing screws.

E. Finishes:

1. Aluminum subchannels and tread plates shall be:

a. Mill finish.

b. Heat-treated for strength.

c. Clear acrylic lacquer coated for components to be embedded in concrete. This does not include cast nosings.

2. Cast abrasive nosings and tread plates shall be:

a. Cast aluminum standard surface and nose cross-hatched abrasive.

b. Cast aluminum shall have a natural sand cast finish.

3. Abrasive ribs shall be: C-10 Black standard.

2.8 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience. Conform to the requirements of Form 817, Section 6.01 and M.03.01, Class 'F' and ASTM C-94. Batch mixing at site not acceptable.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 4400 psi.

2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.

3. Slump Limit: 4 inches, plus or minus 1 inch (25 mm).

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: 6 percent plus or minus 1.5 percent for 1-inch (25-mm) nominal maximum aggregate size.

D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph (5 km/h).

2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).

3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of [1/2 inch (13 mm)] according to requirements in Section 31 20 00 "Earth Moving."

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Conform to article 9.21.03-3 of Form 817. Forms shall be true to line, grade, and radius shown. Poorly formed curves will not be accepted.

B. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

C. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT INSTALLATION

A. General: Comply Section 03 21 00 “Concrete Reinforcing”

B. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.

1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.

2. Provide tie bars at sides of paving strips where indicated.

3. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Expansion/Isolation Joints: Form Expansion/isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 20 foot on center unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Tooled/Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch (6-mm) radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch (6-mm) radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete according to ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels and joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.

2. Do not use frozen materials or materials containing ice or snow.

3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

K. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.

3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Steps: Horizontal surfaces are to receive float finish. Vertical surfaces are to receive rubbed finish. Conform to CTDOT Form 817, article 6.01.03-10.b.

C. Eliminate all blemishes, pock marks, and honeycombing.

D. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true

planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, medium to fine-line texture.

3.8 DETECTABLE WARNING SQUARE CAST IRON PAVER

A. Install detectable warning in accordance with manufacturer's instructions at locations indicated on the drawings.

B. Any cutting required to fit detectable warning to an abutting piece, shall be done making every effort that cut line does not bisect the tactile domes, but falls between them. If cuts do bisect a dome, then the edge of the cut dome must be ground to meet ADA requirements for change in vertical grades. Cut pieces shall be dry fitted to ensure tight butt joint between plates prior to placing tactile warning in wet concrete.

C. Set pavers in wet concrete at final position. Keep wet concrete off of the top surface of the pavers at all times.

D. Press pavers into wet concrete to final elevation.

E. Finish concrete around assembled pavers.

F. Pavers must be flush with abutting concrete surface and flush curbing.

3.9 TWO-COMPONENT STAIR NOSING SYSTEMS

A. Install stair nosings in accordance with the governing regulations, the industry standards applicable to the work, and the manufacturer's written installation instructions.

1. Sub-channels of two component stair nosings shall be installed with the pour.

2. Abrasive tread plates of two component stair nosings shall be installed in the final stages of construction.

B. Work shall be aligned plumb, level, and, where required, flush with adjacent surfaces and rigidly anchored to the substrate.

3.10 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Concrete shall be liquid membrane-forming cured and protected as specified in accordance with Article 4.01.03-F.7(a) of CTDOT Form 817.

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

a. Water.

b. Continuous water-fog spray.

c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm) and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period using cover material and waterproof tape.

3.11 SEALANT INSTALLATION

A. Install joint sealant in all expansion joints in accordance with manufacturer's installation instructions. Remove dust, dirt and loose material. Clean and prime joints.

B. Apply sealants in continuous beads, without open joints, voids, or air pockets. Hand tool and finish all joints.

C. Confine materials to joint areas with masking tape or other precautions. Insure joint sealing is cleanly executed with no override onto adjacent pavement.

D. Remove excess compound promptly as work progresses and clean adjoining surfaces. Protect until fully cured.

E. In rough surfaces or joints of uneven widths, hold joint sealant well back into joints.

3.12 WATER REPELLANT AND CHLORIDE SCREEN

A. Apply water based water repellant and chloride screen per manufacturer's instructions.

3.13 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 (ACI 117M) and as follows:

1. Elevation: 1/4 inch (19 mm).

2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).

3. Surface: Gap below 10-foot- (3-m-) long, unleveled straightedge not to exceed 5/16 inch (13 mm).

4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches (13 mm per 300 mm) of tie bar.

5. Lateral Alignment and Spacing of Dowels: 1 inch (25 mm).

6. Vertical Alignment of Dowels: 1/4 inch (6 mm).

7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches (6 mm per 300 mm) of dowel.

8. Joint Spacing: 3 inches (75 mm).

9. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.

10. Joint Width: Plus 1/8 inch (3 mm), no minus.

3.14 FIELD QUALITY CONTROL

A. Testing and inspection: Conform to Section 033000 requirements.

B. Strength of each concrete mixture will be satisfactory if 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 (3.4 MPa).

C. Test results shall be reported in writing to Architect, 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.

D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

E. 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.

F. Concrete paving will be considered defective if it does not pass tests and inspections.

G. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

H. Prepare test and inspection reports.

3.15 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

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. Precast concrete curbs.

B. Related Requirements:

1. Section 321216 "Asphalt Paving" for asphalt base under unit pavers.
2. Section 321313 "Concrete Paving".

1.3 REFERENCE STANDARDS

A. Form 817-2019 shall mean the State of Connecticut, Department of Transportation Standard specifications for Roads, Bridges and Incidental Construction, Form 817-2019 or its latest edition and any supplemental specifications.

1.4 PERMITS/APPROVALS

A. Obtain approval of construction and secure all permits for work in R.O.W. areas. Contractor shall be licensed to R.O.W. holder and pay all fees.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 SUBMITTALS

A. Product Data: For materials other than water and aggregates.

B. Product Data: For the following:

1. Precast concrete curbs including straight sections, inside radius and outside radius.

C. Connecticut High Performance Building Submittals:

1. Recycled content materials.
2. Local materials.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store precast concrete curbing on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

1.8 FIELD CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Limitations for Mortar and Grout:

1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F (38 deg C) and higher.

a. When ambient temperature exceeds 100 deg F (38 deg C), or when wind velocity exceeds 8 mph (13 km/h) and ambient temperature exceeds 90 deg F (32 deg C), set pavers within 1 minute of spreading setting-bed mortar.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of curb, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 CURBS

A. Precast Concrete Curbs: conform to Form 817-2019 Article M.03.01 Class F and the following:

1. Minimum 28 days compressive strength of 5,000 psi

2. Air entrainment: 5 to 7 percent.

B. Minimum length:

1. Straight curbing – 80% of the curbs shall be furnished in lengths of not less than 6 feet, and the remaining 20% in lengths of not less than 4 feet, interspersed at random, to allow for closures.

2. Radius curbing – curbs to be set on a radius of **100 feet or less** shall be cast to the curve required, and their ends shall be cast on radial lines. Requirements for length of individual curbs in curved curbing vary with radii of curves.

3. **Provide inside and outside radius curb where indicated on the drawings**.

C. Special pieces: provide slope transition curbs, 180-degree bullnose, 90-degree driveway corners, and other special pieces as indicated.

2.3 ACCESSORIES

A. Compressible Foam Filler: Preformed strips complying with ASTM D 1056, Grade 2A1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas indicated to receive curbing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Do not use curbing with chips, cracks, voids, discolorations, or other defects that might be visible in finished work.

B. Curbing:

1. Install curbing to the lines, grades, and details shown in the drawings. Conform to Form 817-2019 Article 8.11.03, for precast concrete curbing; and the following requirements:

   a. Subgrade

      1) Insure all utility conduit have been installed prior to backfill/subgrade preparation. Prepare subgrade by removing all soft or spongy material and backfilling with suitable material.

      2) Compact the surface uniformly to 95% Modified AASHTO Laboratory density (ASTM D-1557, Method C).

      3) Coordinate testing of subgrade and base with the Owner. Do not install base materials until schedule testing procedures are complete.

   b. Base

      1) Place maximum 6” layers.

      2) Compact each layer uniformly to 95% Modified AASHTO Laboratory density (ASTM D-1557, Method C).

   c. Curb Installation

      1) Set on edge. Settle into place with a heavy wooden hand rammer.

      2) Joints:

         a) Place concrete at the curb joints as shown on the drawings. Insure that top exposed edge of curb face is consistent and true to line and grade. Support curb as required until concrete cures and all backfill operations have been completed.

         b) Point joints with mortar for the full depth and width of curbing. Conform to the details on the drawings.

         c) Omit concrete bed and mortar joint at 50 (+/-) foot intervals along curb installation to allow for expansion.

      3) Backfill with approved material.

3.3 REPAIRING AND CLEANING

A. Remove and replace curbing sections that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and

install in same manner as original units, with same joint treatment and with no evidence of replacement.

B. Cleaning: Remove excess grout from exposed curbing surfaces; wash and scrub clean.

END OF SECTION 321400

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 precast concrete wheel stops.

B. Related Requirements:

1. Section 321216 "Asphalt Paving" for asphalt base under unit pavers.
2. Section 321313 "Concrete Paving".

1.3 SUBMITTALS

A. Product Data: For each type of product.

B. Connecticut High Performance Building Submittals:

1. Recycled content materials.
2. Local materials.

C. Samples for Initial Selection: For each type of exposed finish requiring color selection.

D. Samples for Verification: For wheel stops, 6 inches long, showing color and cross section; with fasteners.

PART 2 - PRODUCTS

2.1 PARKING BUMPERS

A. Concrete Wheel Stops: Precast, steel-reinforced, air-entrained concrete, 4000-psi minimum compressive strength, 6 inches high by 9 inches wide by 72 inches long. Provide chamfered corners, transverse drainage slots on underside, and a minimum of two factory-formed or -drilled vertical holes through wheel stop for anchoring to substrate.

1. Surface Appearance: Free of pockets, sand streaks, honeycombs, and other obvious defects. Corners shall be uniform, straight, and sharp.
2. Mounting Hardware: Galvanized-steel spike or dowel, 1/2-inch diameter, 12-inch minimum length.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install wheel stops according to manufacturer's written instructions unless otherwise indicated.

B. Securely anchor wheel stops to pavement with hardware in each preformed vertical hole in wheel stop as recommended in writing by manufacturer. Recess head of hardware beneath top of wheel stop.

END OF SECTION 32 17 13

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. All related specification sections shall be used in conjunction with this Section.

1.2 SUMMARY

A. Pavement marking as indicated on the Drawings, to include but not be limited to:

1. Directional arrows.
2. Parking Stalls.
3. Handicap/Accessible Parking Stalls and Symbols.
4. Replacement of pavement markings disturbed as part of construction activities.
5. Other markings as may be required.

B. The work of this Section shall also consist of furnishing and installing sheet aluminum/reflective sheeting signs and galvanized steel support posts as indicated on the plans.

C. Related Work: The following sections contain requirements that may apply to this section:

1. Section 32 12 16 – “Bituminous Asphalt Concrete Paving”

1.3 REFERENCE STANDARD

A. State of Connecticut Department of Transportation Standard Specifications for Road and Bridge Construction (Form 817).

B. Manual on uniform traffic control devices.

C. American Society for Testing and Materials (ASTM)

D 522	Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
D 562	Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer
D 711	Standard Test Method for No-Pick-Up-Time of Traffic Paint
D 968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasives
D 969	Standard Test Method for Laboratory Determination of Degree of Bleeding of Traffic Paint
D 1210	Standard Test Method for Fineness of Dispersion of Pigment-Vehicle Systems by Hegman-Type Gage
D 1394	Standard Test Methods for Chemical Analysis of White Titanium Pigments
D 1640	Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature

D 1729	Standard Practice for Visual Appraisal of Colors and Color Differences of Diffusely Illuminated Opaque Materials
D 1849	Standard Test Method for Package Stability of Paint
D 2243	Standard Test Methods for Freeze-Thaw Resistance of Water-Borne Coatings
D 2244	Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
D 2369	Standard Test Method for Volatile Content of Coatings
D 2486	Standard Test Methods for Scrub Resistance of Wall Paints
D 2697	Standard Test Method for Volume Nonvolatile Matter in Clear or Pigmented Coatings
D 2805	Hiding Power of Paints by Reflectometry
D 3335	Standard Test Method for Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy
D 3718	Standard Test Method for Low Concentrations of Chromium in Paint by Atomic Absorption Spectroscopy
D 3723	Standard Test Method for Pigment Content of Water-Emulsion Paints by Low-Temperature Ashing
E-1347	Standard Test Method for Color and Color-Difference Measurement by Tristimulus (Filter) Colorimetry
G 154	Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

1.4 SUBMITTALS

A. Submit under provisions of Division 1.

B. Submit material specifications for all materials furnished under this section including but not limited to the following:

1. Material Safety Data Sheets
2. Pavement Marking Paint
3. Handicap/Accessible Parking Stalls and Symbols.
4. Replacement of pavement markings disturbed as part of construction activities.
5. Other markings as may be required.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Paint shall meet pavement requirements of AASHTO M248, Type N for regular dry pavement.

B. Parking bay marking shall be a chlorinated rubber base traffic land marking paint, factory mixed, quick drying and non-bleeding complying with Federal Specification TT-P-115, Type III, color: as noted on plans.

1. Provide white paint for directional arrows, parking stalls, handicap stalls, and hatching, and stop bars on asphalt and concrete within the parking area.

C. Roadway pavement markings shall be TT-P-1952E, Type III, reflectorized paint. Glass beads shall conform to TT-B-1325.

D. Block out Paint: Line block out paint shall be TT-P-110C; color shall be black.

E. Color FED-STD-595 color chip shall be as follows.

1. White – 37925

2. Black – 37038

F. Signs and support posts shall conform to the requirements of Article 12.08.02 of the Connecticut Department of Transportation Form 817.

2.2 PROHIBITED MATERIAL

A. The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, toluene, chlorinated solvents, hydrolysable chlorine derivatives, ethylene-based glycol ethers and their acetates, nor any carcinogen, as defined in 29 CFR 1910.1200. The lead content shall not exceed 0.06 percent by weight of the dry film and the test for chromium content shall be negative.

PART 3 - EXECUTION

3.1 GENERAL

A. Pavement shall be cleaned of all dirt, oil and other matter prior to painting.

B. Parking and pavement marking shall be laid out and reviewed by the Engineer prior to painting.

C. Paint shall not be placed on damp pavement or within 24 hours of the last precipitation.

D. The Contractor shall be responsible for securing the area in order to allow the paint sufficient time to dry.

3.2 INSTALLATION

A. Equipment:

1. Use atomizing spray-type equipment, guides, and templates designed for the purpose and which are also designed to apply strips, symbols, and letter of uniform size and cross section, with clear-cut edges and uniform thickness for the coverage specified.

B. Layout of the Work:

1. Provide sufficient control points to permit application of stripes, directional arrows, messages, crosswalk marking, and parking space delineations as shown on the drawings.

a. Locate and layout marking in a manner that will not interfere with adhesion of paint or leave permanent non-specified markings.

C. Application:

1. Surface Conditions: Do not apply paint to new bituminous pavement until 48 hours after pavement has been placed. Cleaning: Clean the surface of areas to be painted of dust, dirt, laitance, oil, and other foreign substances detrimental to paint adhesion.

2. Painting:

   a. Apply paint only during daylight hours. Except for special area and markings requiring hand painting, apply all pavement marking by machine.

   b. Suspend painting operations when wind conditions are such that blowing of spray-applied paint and deposit of dust on newly applied paint is likely.

   c. Sweep and clean surface to eliminate loose material and dust. Do not begin marking asphalt surfacing until acceptable by the Owner's representative.

   d. Paint shall be asphalt base traffic paint applied in accordance with the manufacturer's recommendations with a width as shown on the plans and a thickness of not less than 12 nor more than 18 mils.

   e. Apply paint with mechanical equipment to provide uniform straight edges. Apply in two coats at manufacturer's recommended rates. Paint shall be applied at a rate of 100 square feet to 115 square feet per gallon.

   f. Quick drying, hot applied paint shall be applied at a temperature of 120° F to 150° F at the spray gun.

   g. Proceed with pavement marking only on clean, dry surfaces and at a minimum and rising ambient or surface temperature of 40° F for oil-based materials and 55° F for water-based materials, and not exceeding 95° F.

D. Protection:

1. Markings shall remain protected until sufficiently dry to bear traffic on roadways that are open to traffic.

2. Precautions shall be taken to prevent tracking by tires of the striping equipment.

E. Corrective Measures:

1. Repair or remove and reapply any pavement markings that fail to satisfy the requirements indicated. Submit proposed means of cleaning, removing, or obliterating unsatisfactory markings to the Architect for approval prior to commencing corrective work. Use materials for cleaning pavement of spills, spatter, or overspray that will not injure the paved surface.

F. Signs and support posts shall be installed in accordance with Article 12.08.03 of the Connecticut Department of Transportation Form 817.

END OF SECTION 32 17 23

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The general provisions of the contract including general and supplementary conditions, and general requirements apply to the work specified in this section.

1.2 SECTION INCLUDES

A. Baseball and softball skinned sand-clay surfaces as shown on the drawings and specified herein, including but not necessarily limited to:

1. Sand cushion.
2. Infield, home plate and pitcher's mound construction.
3. Coach's boxes and on-deck circles.
4. Infield topdressing and soil conditioner.
5. Pitcher's mound
6. Warning track material

1.3 REFERENCES

A. ASTM F2107-01: Standard Guide for Construction and Maintenance of Skinned Areas on Sports Fields.

1.4 RELATED SECTIONS

A. Section 11 68 33, "Athletic Field Equipment"

B. Section 31 20 00, "Earth Moving"

C. Section 32 18 24, "Natural Ball Field Surfacing"

1.5 SUBMITTALS

A. Submit infield mix producer's sieve analysis, product data, and installation instructions for each product specified here in.

B. Submit Certified Sieve Analysis of coarse sand.

C. Submit sample of infield mix to infield conditioner manufacturer's technical representative for determination of quantity of conditioner required.

1.6 PROJECT CONDITIONS

A. Coordinate with irrigation equipment installation if applicable.

PART 2 - PRODUCTS

2.1 INFIELD MIX:

A. Material Mix: 72% sand, 12% silt, 16% clay mix

B. Performance:

1. Infield mix shall be clean, dry clay mixed with washed mason-type sand resulting in a weed-free mixture that is reddish brown in color having a yield of 1.35 tons per cubic yard when placed loose or 1.5 tons per cubic yard when compacted 85% - 90% on a Standard Proctor Test (ASTM D 689-07). The material possesses the following particle size analysis:

   a. Total sand content shall be 70-75 percent.

   b. The combined amount of sand retained on the medium, coarse and very coarse sieves shall be greater than or equal to 50 percent.

   c. The combined amount of silt and clay shall be 25-30 percent.

   d. The ratio of silt divided by clay, otherwise known as the SCR, shall be 0.5 – 1.0.

   e. No particles greater than 3 millimeters.

   f. Equal to or less than 5 percent of particles shall be retained on the 2 millimeter.

2.2 SAND CUSHION: Concrete Sand conforming to CTDOT Form 817. Article M.03.01-2 "Fine Aggregate."

2.3 TOPDRESSING AND SOILS CONDITIONER

A. Performance:

1. Topdressing shall be red (or brown) in color, having a yield of approximately 55 pounds per cubic foot (0.81 tons per cubic yard) and possessing the following particle size analysis:

Sieve Designation	Range of % Passing
No. 4	100%
No. 6	78% - 90%
No. 8	45% - 65%
No. 16	0% - 10%
No. 30	0% - 1%
No. 50	0% - 1%
No. 100	0% - 1%
Pan	0%

2.4 PITCHER'S MOUND CLAY AND BATTER'S BOX SURFACES

A. Performance:

1. Pitching mound and batter's box clay is clean, dry clay that is grayish brown in color having a yield of 1.5 tons per cubic yard and possessing the following particle size analysis:

   a. Total sand content shall be 5-15 percent.

   b. The overall clay content shall be greater than 50 percent.

2.5 WARNING TRACK:

A. Performance:

1. Warning Track material shall be New England Crimson Red Stone Dust possessing the following particle size analysis:

Sieve Designation	Range of % Passing
3/8"	100
No. 4	90 - 100
No. 8	65-82
No. 16	42 - 60
No. 30	35 - 45
No. 50	25 - 32
No. 100	15 - 22
No. 200	0 - 12

2. Warning track material will be placed on top of a gravel subbase meeting CTDOT form 817, M.02.06, Grade A requirements.

3. Geotextile shall be non-woven, free draining and approved by the engineer.

2.6 ADDITIONAL INFIELD MATERIALS:

A. The Contractor shall supply the owner with the following excess material for future use: eighty (80), fifty (50) pound bags of infield mix, forty (40), fifty (50) pound bags of topdressing/soils conditioner, and twenty (20), fifty (50) pound bags of pitcher's mound clay material.

PART 3 - EXECUTION

3.1 GENERAL

A. Install to the lines, grades, and details shown on the drawings and in conformance with the material producer's written instructions and recommendations.

B. Verify that the subgrade has been properly prepared and compacted.

3.2 INSTALLATION - SKINNED SURFACES

A. Stockpile materials at the edges of the skinned areas. Use tracked equipment to spread into place.

B. Install sand cushion. Wet and roll sand cushion immediately prior to spreading infield mix.

C. Install infield mix in two layers:

1. Place first layer to a depth of 3-inches over the wet sand cushion. Spread, smooth and compact. Scarify surface.

2. Place second layer to a depth of approximately 3-inches. Spread, and roll to obtain a firm surface.

D. Total thickness of infield mix in-place after compaction: 4-inches. Surface shall be smooth and shall be pitched for drainage as indicated on the drawings.

E. Moisten, patch low spots, roll and drag to create a firm playing surface with a soft cushion for safe sliding. Surface shall retain only enough moisture for resilience.

F. After infield mix has been installed to required depths, lightly moisten the entire skinned area.

G. Following successful inspection, topdressing shall be applied to the surface for optimum product performance.

H. Topdressing shall be added at a rate of 1 pound per 1 square foot for new construction.

I. A minimum of one (1) fifty pound bag shall be reserved for the pitcher's mound.

J. Spread topdressing evenly throughout the skinned areas. Bags of material shall be aligned approximately 42"-60" apart in both directions, depending on application rate.

K. Once bags are properly positioned, open bags and dump material. Remove all bags from field.

L. With a blade, mat drag, or landscape rakes, level all of the material piles and spread evenly across the surface.

M. Topdressing layer shall be 1/8"-1/4" thick surface layer on top of the 4" infield skin surface.

N. The finished surface of the infield shall be smooth and free from any visible dips, humps, bumps or other blemishes which would hinder the removal of water through positive surface drainage. Where warranted, a finished elevation survey shall be conducted to assure proper installation.

O. Insure that infield finish surface grades conform with grading plans. Insure that lawn grades and skinned surfaces are flush to each other, and that drainage patterns are not interrupted.

3.3 INSTALLATION – PITCHER'S MOUND AND BATTER'S BOX SURFACES

A. Place the material in lifts of 2 inches and compact with a vibratory device until an optimum compaction between 90 percent and 95 percent is achieved. Scarify the surface to facilitate bonding of the next lift and repeat until finish grade elevation is achieved. Completing this process as described will minimize settling and improve the performance of the product.

B. Depth of the material shall vary when finished and compacted.

C. In most cases, the material is delivered with optimum moisture and adding water is not necessary. If unable to achieve optimum compaction, a light application of water may be needed.

D. The finished surface of the infield shall be smooth and free from any visible dips, humps, bumps or other blemishes which would hinder the removal of water through positive surface

drainage. In some instances, and where warranted, a finished elevation survey shall be conducted to assure proper installation.

E. Following successful inspection, topdressing shall be applied to the surface for optimum product performance. This topdressing is either expanded shale or calcined clay product and shall be added at a rate of 0.5 pounds per 1 square foot for maintenance, or 1 pound per 1 square foot for new construction.

F. Apply infield soil conditioner to the pitcher's mound so that it is fully incorporated in the top 3 inches of the pitcher's mound finished surface.

3.4 INSTALLATION – WARNING TRACK

A. First, excavate material from the warning track area to a depth of 7 inches below the final finished grade.

B. Compact the subgrade until 90 to 95 percent compaction is achieved.

C. Install geotextile fabric to prevent future weed migration through the warning track area.

D. On top of the geotextile fabric, place 4 inches of gravel subbase material conforming to CTDOT form 817, M.02.06 Grading A.

E. Finally, place the New England Crimson Stone Dust material over the top of the gravel subbase. The depth of the New England Crimson material should be 3 inches at completion after compaction.

F. When placing the warning track material, use lifts of 2 inches and compact with a minimum 1-ton vibratory roller until an optimum compaction between 90 percent and 95 percent is achieved. Scarify the surface to facilitate bonding of the next lift and repeat until finish grade elevation is achieved. Completing this process as described will minimize settling and improve the performance of the product.

G. The warning track must have a 1 percent slope toward the outfield fence.

H. The finished surface of the warning track shall be smooth and free from any visible dips, humps, bumps or other blemishes which would hinder the removal of water through positive surface drainage. Where warranted, a finished elevation survey shall be conducted to assure proper installation.

3.5 MAINTENANCE

A. Maintain until final acceptance by raking and rolling, to produce a smooth even surface with no weeds or other debris. Infield surfacing will not be accepted until all lawn areas are established, maintained, and accepted.

B. Repair any settlements by installing additional material and rolling to a smooth surface.

C. Apply additional infield mix as directed.

END SECTION 32 18 21

ISSUED for BID

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 DESCRIPTION OF WORK

A. Furnish all labor, equipment and materials necessary to construct a permeable stone base, shock absorbing pad, and dual fiber synthetic turf surfacing system with acrylic coated sand infill, including all tufted and/or inlaid sports field lining and marking as specified and indicated on the Drawings.

B. Each Turf Supplier/Installer will meet or exceed the requirements of this specification related to materials, performance, and qualifications.

C. Work shall include but shall not be limited to:

1. Provide an inspection and certification of subsurface drainage system and Free Draining Base prior to commencement of subsequent work.
2. Furnish and install an In-filled Synthetic Turf System including free draining base, parallel long-slit and monofilament polyethylene fibers with nominal height of 1.75" tufted into a high-quality polyurethane coated backing with an acrylic coated sand infill.
3. Provide infiltration testing by means of Dual-Ring Infiltrometer at a minimum of six (6) locations after completion of Free Draining Finishing Stone layer.
4. Provided tufted, inlaid and painted lines and markings or other such graphics as described herein and shown on the Contract Drawings and approved Shop Drawings.
5. Provide all attachments and penetrations as required to complete the work as shown on the Contract Drawings and approved Shop Drawings, all in full compliance with CIAC and NFHS rules for the intended sports.
6. Provide eight (8) year warranty and field maintenance training as further described within this section.
7. Provide Third Party Insured Warranty as further described within this section.

1.3 GENERAL REQUIREMENTS

A. It is the intent of this specification to specify an Infilled Synthetic Turf System that provides a high-quality playing surface for multi-purpose athletic uses installed by experienced crews under the direct supervision of an experienced foreman/superintendent. The finished surfaces shall be immediately firm, and stable while providing long term durability, safety, and shock attenuation. The Infilled Synthetic Turf System Supplier/Installer's attention is called to the testing requirements related to G-Max rating per ASTM F355-01, current edition.

1. The synthetic turf supplier/installer must have completed a minimum of fifteen (15) outdoor installations, each in excess of 80,000 S.F. in the Northeast Region, incorporating a tufted polyethylene infilled turf system.

2. The crew foreman shall have supervised the installation of at least ten (10) similar filled turf installations.

3. The General Contractor shall submit a list of previously installed projects, to include individual Owner contact information, by the proposed Synthetic Turf Supplier/Installer, along with crew and foreman qualifications at the pre-construction conference that demonstrates compliance with the minimum requirements of this section.

4. The General Contractor must coordinate all work items with the Turf Supplier/Installer.

1.4 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirement shall govern.

1. American Society for Testing and Materials (ASTM):
   a. D 1557 Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu.ft (2,700 KN-m/cu.m.))

   b. F 355A Shock Absorbing Properties of Playing Surface Systems and Materials.

   c. D 5034 Grab Breaking Strength

   d. D 418 Pile Height, Tuft Spacing, Face Weight and Total Weight

   e. D 2859 Flammability (Pill test)

   f. F 1551 Shoe Traction

   g. F 1551 Water Permeability

   h. F 1015 Abrasive Index

1.5 SUBMITTALS

A. Manufacturer's Literature

1. Submit a signed statement from the Infilled Synthetic Turf System Manufacturer that the Drawings and Specifications have been reviewed by a qualified representative of the Infilled Synthetic Turf System Manufacturer and major materials suppliers, and that they are in agreement that the materials and installation methods to be used for the Infilled Synthetic Turf System are proper and adequate for use as a multi-purpose athletic field in New England.

2. Submit a recent reference list for the turf system installer of at least five (5) outdoor high school or college installations, each in excess of 80,000 S.F. incorporating a dual fiber synthetic turf system similar to that proposed for this project. Minor variations in infill design in projects cited for experience are acceptable.

3. Submit a recent reference list for the turf system installer of at least fifteen (15) outdoor installations, each in excess of 80,000 S.F. incorporating a tufted polyethylene infilled turf system.

4. Job resumes of Infilled Synthetic Turf System Manufacturer's Installation Supervisor (showing supervision of at least ten (10) similar infilled turf installations) and Infilled Synthetic Turf System Installers.

5. Cut Sheets for all materials required under this Section (turf, fiber, shock pad, coated sand, etc.) including third party ASTM certified lab gradation reports.

6. Provide a sample written 8-year labor and materials warranty from the Infilled Synthetic Turf System Manufacturer.

7. Provide a sample Written Third Party Insured Warranty (described herein) at the pre-construction conference.

8. A signed letter on turf manufacturer company letterhead holding the Owner, Designer and all other project consultants harmless for any violation of patent rights or infringements and claims related to hazardous materials (e.g. lead or zinc) or other environmental impacts.

B. Shop Drawings

1. Provide a carpet seaming plan.

2. Supply shop drawings (including details) at an approved scale for location, installation, and erection of the synthetic turf anchoring system.

3. Provide a striping and marking plan for all intended sports which includes layout for soccer in compliance with NFHS, CIAC, and the Drawings for approval by the Owner and Designer.

C. Product Samples and Information

1. Provide color samples of manufacturer's dual-fiber polyethylene fiber for approval.

2. Provide a minimum of 12" x 12" sample of dual-fiber polyethylene carpet. Provide additional carpet samples for other colors required under this Section.

3. Provide 12" long sample of seaming tape.

4. Provide a 12”x12” sample of the shock absorbing pad.

5. Provide a 1-quart sample of the infill material.

D. Delivery slips for all aggregate base and Infilled Synthetic Turf System materials delivered to the site.

E. Provide three (3) copies of the synthetic turf manufacturer's Maintenance Manual to the Owner. The synthetic turf manufacturer shall also provide the necessary instructions and training for proper care and preventative maintenance of the synthetic turf system.

F. Substrate Acceptability: Submit a certified statement issued by the synthetic field surfacing materials Supplier/Installer, attesting that all areas and surfaces designated to receive synthetic field surfacing have been inspected and found satisfactory for the reception of the Work covered under this Section; and are not in conflict with the "Guarantee" requirements. Installation of synthetic field surfacing materials may not commence until final acceptance of finished crushed stone/aggregate base has been received by the Engineer.

G. Statement of Supervision: Upon completion of the Work, submit a written statement signed by the Synthetic Turf Supplier/Installer stating that the field supervision of the manufacturer's representative was sufficient to insure proper application of the materials, that the Work was installed in accordance with the Contract Documents, and that the installation is acceptable to the manufacturer.

H. Synthetic Turf Supplier/Installer shall provide a written statement that their product is lead free prior to installation.

1.6 QUALITY ASSURANCE

A. Inspection and Acceptance: The Infilled Synthetic Turf System Supplier/Installer and General Contractor shall inspect the subgrade and drainage system to verify their acceptance of installation and condition in writing, per Section 1.05 (G). The turf manufacturer/installer shall include in their cost sufficient site visits during subbase and base construction and pad installation, along with any testing they require to determine the adequacy of the drainage and base construction. Commencement of subsequent installation in a given work area indicates acceptance of underlying substrates and systems. Testing of drainage capacity shall be by Dual Ring Infiltrometer at a minimum of six (6) locations after completion of free draining finishing stone. The Owner's testing and inspection consultant shall be present for these testing operations.

B. Planarity and Grade: Deviation in planarity of the Free Draining Finish Stone layer and finished surface shall not exceed 1/4" beneath a 10' straightedge. Deviation from a straight grade between levels on drawings shall not exceed 1/4". Final grading shall be performed with a dual laser-controlled finish grader.

C. Protection: Only low ground pressure equipment shall be allowed on the subbase or base surfaces of the field. Heavy equipment, dual articulating vehicles, lulls, or vehicles of any kind without flotation tires shall not be allowed on the field area subsequent to the completion of the drainage system.

1.7 TESTING AND INSPECTION

A. The General Contractor shall engage a materials testing agency. The testing agency will observe the aggregate placement, concrete placement, drainage product installation, backfill, compaction and moisture and permeability tests. Weekly testing results shall be provided to the Owner for review. Submission of testing results will be a requirement for the processing of partial payment requests.

B. The Contractor's Geotechnical Engineer of Record will conduct a field infiltration tests of the in-place base and subbase materials per ASTM D3385, Standard Test Method for Infiltration Rate of Soils in Field using a Dual-Ring Infiltrometer or an equivalent percolation test to affirm the subsurface drainage system's water permeability rates prior to carpet installation.

C. In addition to the required Dual-Ring Infiltrometer testing, the Contractor shall verify that the subsurface drainage system is functioning properly prior to the commencement of the infilled synthetic turf system installation by thoroughly flooding the field in a minimum of six (6) areas and verifying and recording flow from the drainage system outlet. This can also be accomplished by recording a naturally occurring rain event with greater than ½" of rainfall.

D. G-Max:

1. The General Contractor shall provide the necessary testing data to the Owner, verifying that the finished field meets the required shock attenuation (GMax), as per ASTM F355/F1936: Immediately upon substantial completion, the General Contractor shall arrange for shock absorbency testing by a certified laboratory subject to approval by the Designer in accordance with ASTM F 335-Method A. Testing will be performed at a minimum of ten locations selected by the Designer. "In-house" laboratories with a business affiliation to the turf manufacturer and/or installer are unacceptable.

2. The average G-max value at installation shall be below 130. The Synthetic Turf Installer, prior to acceptance, shall remedy an average G-max value outside this range, or individual reading more than 15% outside this range. Satisfactory G-max testing shall be a fixed requirement for final acceptance of the synthetic turf installation.

3. Over the life of the guarantee, the Synthetic Turf Manufacturer/Installer shall arrange and pay for annual re-testing of the field using the same procedure if requested by the Owner. The Synthetic Turf Manufacturer/Installer shall take whatever action is required to remedy any average G-max value greater than 15% of the average value at installation, and to remedy any areas with individual readings over 160. These costs will be included in the turf unit price proposal. Over the life of the warranty, changes in the average G-Max that exceed +15% of the original installed system shall be remedied by the synthetic turf manufacturer/Installer within 30-days of the deficient test result.

E. HIC:

1. The General Contractor shall provide the necessary testing data to the Owner, verifying that the finished field meets the required hemisphere impact attenuation (HIC), as per ASTM F1292. Immediately upon substantial completion, the General Contractor shall arrange for HIC testing by a certified laboratory subject to approval by Designer. Testing will be performed at a minimum of ten locations selected by the Designer “In-House” laboratories with a business affiliation to the turf manufacturer and/or installer are unacceptable.

2. The HIC value at installation shall be below 1,000 at 1.3m for each location tested.

3. Over the life of the guarantee, the synthetic turf manufacturer/installer shall arrange and pay for annual re-testing of the field using the same procedure if requested by the Owner. The synthetic turf manufacturer/installer shall take whatever action is required to remedy any HIC value greater than 1,000. These costs will be included in the turf unit price proposal. Over the life of the warranty, changes in HIC values greater that 1,000 shall be remedied by the synthetic turf manufacturer/installer within 30-days of the deficient test result.

F. Vertical Deformation (AAA):

1. The General Contractor shall provide the necessary testing to the Owner, verifying that the finished field meets the required vertical deformation test using the Advanced Artificial Athlete (AAA) method. Immediately upon substantial completion, the General Contractor shall arrange for testing by a certified laboratory subject to approval by the Designer. Testing will be performed at a minimum of ten locations selected by the Designer "In-House" laboratories with a business affiliation to the turf manufacturer and/or installer are unacceptable.

2. The vertical deformation value at installation shall be between 5mm and 10mm.

1.8 WARRANTY

A. Refer to Section 017830 "Warranties and Bonds – CMR".

B. The Synthetic Turf Supplier/Installer shall provide a written guarantee stating that all work executed under this section will be free from defects of material and workmanship for a period of eight (8) years from date of Substantial Completion, and that any defects will be remedied on written notice at no additional cost to the Owner. The warranty shall be in writing and shall be signed by the Installer and synthetic field surfacing materials manufacturer. Guarantee shall include removal and replacement of materials as required, to repair synthetic field surfacing at no cost to the Owner. This warranty shall not be pro-rated, rather it shall provide for the full replacement value of defective aspects of the installation throughout the life of the warranty, with no maximum per claim coverage amount. Nothing contained in the manufacturer's written warranty language or failure to provide a manufacturer's written warranty shall supersede or limit the contractual obligations in this Specification.

C. In addition to the manufacturer's/installer's warranty described above, the synthetic turf manufacturer will provide the Owner with a third party insurance policy acceptable to the Owner, pre-paid for a full eight (8) years and not-cancelable, issued in the name of the Owner, by a US Insurance company with an A.M. Best rated "A" or better, which provides the same warranty coverage established above, in the event that the turf manufacturer is unable or unwilling to provide the specified coverage. A copy of the policy will be required prior to the General Contractor contract award and its review and approval by the Owner is a condition of the General Contract award. An executed policy in the Owner's name will be required prior to final payment. Policies that include self-insurance or self-retention clauses shall not be considered.

1.9 FOLLOW-UP VISITS

A. The Turf Manufacturer/Installer shall include in their price, two (2) follow-up visits at six (6) month intervals after the Final Turf Inspection date. The visits shall be scheduled by the Owner or Engineer to inspect the condition of the synthetic turf, infill material, seams, painted lines, anchorage, and peripheral attachments. Items found to require repair, amendment, or replacement shall be the responsibility of the Turf Manufacturer/Installer. Repairs, except those required due to vandalism, shall take place immediately upon notification by the Engineer.

2.1 GENERAL

A. This specification covers the installation of a new outdoor Infilled Synthetic Turf System comprised of tufted, textured/shaped dual-fiber parallel long-slit and monofilament synthetic turf over a resilient polypropylene base and infilled with a rounded and highly uniform quartz sand pigmented and sealed with an acrylic polymer. The installed system shall have a permeability rate between 10 to 16 inches per hour. The tufted synthetic turf is comprised of long-slit and monofilament fibers tufted into a urethane backed, porous carpet, meeting F.D. Doc FF1-70 and ASTM D-2859 flammability requirements, with an abrasion index of less than 25 per ASTM F1015.

2.2 ARTIFICIAL TURF ANCHORING SYSTEM

A. Anchoring system shall be in accordance with the details provided in the construction plans.

2.3 SYSTEM COMPONENTS

A. The turf system consists of the following components:

1. Base Stone, a vertical draining base of crushed stone consisting of a permeable layer of crushed aggregate topped by a permeable Finish Stone course of finer crushed aggregate, 1" or less in thickness.

2. Resilient polypropylene shock-absorbing base pad consisting of an impact energy absorbing sub-base drainage material designed specifically for use with synthetic turf.

3. A synthetic turf carpet consisting of nominal 1.75" long dual-fiber monofilament/long-slit fibers tufted into a permeable double-layered primary backing with a secondary backing.

4. An infill system consisting of a rounded and highly uniform quartz sand pigmented and sealed with an acrylic polymer.

2.4 PREPARATION OF SUBGRADE

A. All topsoil, organic, and non-compactable materials shall be stripped, hauled, and disposed of. If material is encountered below sub-grade elevations that does not meet the compaction requirements, the Contractor must notify the Engineer immediately prior to excavation of in-situ material.

B. The soil bed and subbase materials must be compacted in accordance with Specification Section 31 20 00 - Earth Moving.

C. The soil bed must be prepared to tolerances of not more than 1/4" in 10' from the nominal height to allow for even drainage. Laser grading is recommended.

D. A pervious geotextile fabric shall be installed to cover the soil bed in accordance with installation details.

2.5 BASE STONE

A. Dynamic Base stone shall be clean crushed rock consisting of the angular fragments obtained by breaking and crushing shattered natural rock, free from detrimental quantities of thin or elongated pieces, free from dirt or other objectionable materials, and shall have a percentage of

wear as determined by the Los Angeles Abrasion Test (AASHTO-T96), of not more than 30.

B. Base stone must be laid without damaging the soil bed. It is very important to not create any depressions with heavy equipment. The specified stone or aggregate supplied must conform to the turf manufacturer's recommended specifications, as well as this specification. The crushed stone or aggregate base supplied must be stable and sufficiently permeable to ensure all-weather availability of the field.

C. The base shall be constructed in two (2) or more layers or lifts of approximate equal thickness. Each layer must be compacted in both directions to attain the specified compaction rate.

D. The finished crushed stone base surface of the leveling course shall not vary from the specified grade by more than ¼" in 10' when measured in any direction.

E. Aggregate base beneath final grade shall be a graded, granular, non-frost susceptible, free-drainage material, consisting of either durable stone or coarse sand blends practically free from loam and clay fines, and which can be readily compacted to form a stable foundation, graded as follows:

Sieve Size	% Passing by Weight
1-inch	100
3/4-inch	95-100
1/2-inch	75-95
3/8-inch	45-70
No. 4	30-45
No. 10	15-30
No. 40	5-10
No. 100	0-5
No. 200	0-2

2.6 FINISH STONE

A. The finish stone aggregate layer should not be more than 1" thick.

B. The finish stone shall meet the following gradation requirements:

Sieve Size	% Passing by Weight
1/2-inch	100
3/8-inch	85-100
No. 8	35-75
No. 16	10-55
No. 30	0-40
No. 50/60	0-15
No. 100	0-8
No. 200	0-2

2.7 RESILIENT POLYPROPYLENE SHOCK-ABSORBING BASE PAD

A. An impact energy absorbing sub-base drainage material designed specifically for use with synthetic turf is required. The specified material must have both impact absorption and drainage properties that meet the following requirements:

1. Size: 73.5 x 49 inches interlocking panels.
2. Net coverage per panel 25 square feet.
3. Thickness: 1” (25mm) +/- 0.18”
4. Panel Weight: approximately 5 lbs/panel
5. Vertical drainage at 50” per hour minimum
6. Friction coefficient – movement of artificial turf over 50mm distance 2.0 lbs maximum force ISO 8295-2010.
7. GMAX shall be between 80-120 throughout warranty period. Manufacturer shall provide a GMAX guarantee that shall not exceed 120 G’s for warranty period and provide payment of cost or repair, remediation, full field inspection, refurbishment, and re-testing.
8. HIC not to exceed 900 from a 1.4-meter drop height.
9. When tested with the Deltec field tester, vertical deformation must remain between 6-12 mm.
10. Warranty shall be 25 years or more.
11. Vertical deformation of less than 6mm EN14809 for sub-base without turf overlay.
12. Manufacturer must provide a product lifetime recycle / reuse program.
13. Material thickness tolerance must be a minimum of 25 mm. ASTMD1777.
14. Material must demonstrate 100% closed loop recyclability, recycling for energy not acceptable.
15. Product must be made in the United States of America.
16. Material must not absorb water. Open cell foams not acceptable.

2.8 TURF SYSTEM COMPONENT MATERIALS

A. Carpet

1. Fiber: 1.75-inch long dual fiber system (long-slit and monofilament). It must have the following properties:

ASTM	Property	Specifications
D1577/D1907	Denier (min.)	8000 & 12,000 nominal
D418	Pile Height (min.)	1.75-inch nominal
D418	Pile Weight (min.)	46 oz/sy
Face Yarn Type:	Polyethylene Parallel long-slit and monofilament	
Yarn Thickness:	100 microns (parallel long-slit) 260 Microns (monofilament)	

Pile Height (Finished):	1.75 inches (63.5 mm)
Color:	Green (varies for lines and graphics
Construction:	Broadloom tufted
Tufting Gauge:	3/8-inch
Primary Backing:	8 oz/sy minimum double layered polypropylene fabric treated with inhibitors
Secondary Backing:	20 oz/sy urethane minimum
Total Product Weight:	74 oz/sy minimum (+/- 2 oz) (w/o infill)
Finished Roll Width:	15-feet (4.6 m)
Finished Roll Length:	Up to 240-feet (73 m)
Perforation:	3/16-inch clear holes on staggered 4-inch (min.)
Permeability:	16-inches per hour minimum (w/infill in place)
Tuft Bind:	10 lbs/force minimum
Infill Weight	8 lbs/sf minimum

2. Primary backing: shall be a double-layered UV-treated woven polypropylene, weighing a minimum of 9 oz./sq. yd.

3. Secondary backing: is a permeable application of high-quality urethane, 18-26 oz/sy minimum, heat activated to lock the fiber tufts into the primary backing materials.

B. Infill

1. Rounded and highly uniform quartz sand pigmented and sealed with an acrylic polymer.

2. Silica sand must have a coefficient of uniformity of <= 1.3

3. 98% of the particles retained on US standard sieves 12 through 20.

4. The coated particles shall be smooth to resist mounding and compaction and have an angle of repose of 30 degrees or less.

5. The finished product shall be 100% coated, shall repel water, be non-flammable, and have <.001% dust content.

6. When placed in the synthetic turf, the system shall have an abrasion index of 26+/- 2.

7. Color: Green

2.9 FIELD MARKING

A. Tufted and inlaid lines: shall be in colors as specified in the drawings and meet the above material specifications. Height of all inlaid lines shall be equal to that of the installed turf. Lines shall be tufted into the fabric to the extent possible and remaining shall be field inlaid. Provide all field lines as indicated.

B. Marking Paint: shall be in conformance with NFHS and CIAC regulations, specifically formulated to be compatible with synthetic field surfacing. The contractor must submit a final striping plan for approval by the Owner and Engineer prior to painting of the synthetic turf fields.

2.10 MAINTENANCE EQUIPMENT – FIELD GROOMER

A. The Contractor shall provide a Field Groomer for routinely brushing the field, which shall be a single unit of putting green quality. Drag-type broom unit shall be powder coated steel construction, tow-able with a small tractor, with a 15' brush. Prior to final payment on turf installation, the turf manufacturer shall train the Owner's maintenance personnel on the routine maintenance practices for the synthetic turf field.

PART 3 - EXECUTION

3.1 GRADING

A. Areas to be placed with turf will be compacted and brought approximately to subgrade elevation under Section 31 2000– Earth Moving before work of this section is performed. Final fine grading, filling, and compaction of subgrade to receive turf, as required to form a firm, uniform, and accurate subgrade at required elevations and to required lines, shall be done under this Section.

B. Subgrade of areas to be surfaced with synthetic turf shall be recompacted as required to bring top 9 in. of material immediately below gravel base course to a compaction of at least 90% of maximum density, as determined by ASTM D 1557, Method D. Subgrade compaction shall extend for a distance of a least 1 ft. beyond turf edge.

C. The subgrade shall be inspected by Contractor by means of a laser level on a 10-foot grid pattern. Based on Contractor's inspection of the topographical survey, the Contractor shall fine grade the subgrade suitably, including properly rolling and compacting the base.

D. Excavation required in gravel subgrade shall be completed before fine grading and final compaction of subgrade are performed. Where excavation must be performed in completed subgrade, subsequent backfill and compaction shall be performed as specified in Section 31 2000 – Earth Moving. Completed subgrade after filling such areas shall be uniformly and properly graded.

E. Areas being graded or compacted shall be kept shaped and drained during construction. Ruts greater than or equal to 2 in. deep in subgrade, shall be graded out, reshaped as required, and recompacted before placing gravel base course.

F. Materials shall not be stored or stockpiled on subgrade.

G. Disposal of debris and other material excavated and/or stripped under this section, and material unsuitable for or in excess of requirements for completing work of this Section shall be legally disposed of off-site.

3.2 BASE STONE

A. Aggregate base course for surfacing and the spreading, grading, and compaction methods employed shall conform to the specification.

B. Compaction of aggregate base course shall be to 90-95% of maximum density as determined by ASTM D 1557, Method D. Stone greater than 1 in. shall be excluded from course.

C. Width of base course shall be greater than the width of turf surface, if continuous lateral support is provided during rolling, and shall extend at least two (2) x base thickness beyond edge of the course above, if not so supported.

D. Aggregate material shall be applied in lifts less than or equal to 6 in. thick, compacted measure. Each lift shall be separately compacted to specified density, using a 6-ton steel wheel roller or vibratory roller equivalent to a 6-ton static roller, or an approved equivalent.

1. Material shall be placed adjacent to structures only after they have been set to required grade and level.

2. Rolling shall begin at sides and progress to center of crowned areas and shall begin on low side and progress toward high side of sloped areas. Rolling shall continue until material does not creep or wave ahead of roller wheels.

3. Surface irregularities which exceed 1/4 in. measured by means of a 10-ft. long straightedge shall be replaced and properly compacted.

E. Subgrade and base course shall be kept clean and uncontaminated. Less select materials shall not be permitted to become mixed with gravel. Materials spilled shall not be permitted to become mixed with gravel. Materials spilled outside specified lines shall be removed and areas repaired.

F. Portions of subgrade or of construction above which become contaminated, softened, or dislodged by passing of traffic, or otherwise damaged, shall be cleaned, replaced, and otherwise repaired to conform to the requirements of this specification before proceeding with next operation.

G. Finish stone shall be compacted (95% of the maximum density determined by ASTM D-1557) in both directions.

H. The finish stone material shall be sloped from the center longitudinal axis towards the side lines or as shown on the drawings. This layer must be graded using a dual laser guided fine grading system.

I. A soil test is required on the finished finish stone surface to be covered by the synthetic turf. These tests must provide the following information:

1. Permeability and/or hydraulic conductivity of drainage base (lab)

2. Percolation rate of base (in-situ)

3. Moisture content at the time of the test

4. Sieve analysis and plasticity limits determination test (lab)

5. In-situ compaction (measured)

J. Turf carpet manufacturer shall approve the finish stone planarity and drainage characteristics in writing prior to installation of the turf carpet.

3.3 SYSTEM CHARACTERISTICS

A. Permeability (to ASTM D 4491): The system, turf and base, shall allow a minimum percolation rate of sixteen inches (16") per hour.

B. Relative Abrasiveness (to ASTM F 1015): The system has an Abrasiveness Index of 26+/- 2.

3.4 SYNTHETIC FIELD SURFACING

A. Prior to the installation of turf, the contractor shall have surveyed the area to be covered and the longitudinal and lateral center lines and perimeter edge lines shall be located, marked, and staked 5 ft. outside of the actual limits of the turf surface.

B. After acceptance of the constructed Base, the carpet is laid out on the site and consecutive panels are sewn together at the seams using procedures approved by the Supplier.

C. Synthetic field surfacing shall be installed by crews employed by the synthetic field surfacing manufacturer, in strict accordance with manufacturer's recommendations and instructions including but not limited to fabric, adhesives, seaming tape, sewing line, and abutting adjacent materials.

D. All turf seams shall be sewn with a double-locked stitch approved by the Turf Supplier. Glued seams may be permitted following review of gluing methods and materials and weather conditions by the Engineer. Glued seams shall be backed with seam tape.

E. Seams shall be combed to ensure that threads are not exposed but are hidden within the nap. After grooming, carpet seams which are inconsistent and obvious in the judgment of the Owner's representative will be repaired.

F. Synthetic Turf shall be installed with no wrinkles, ripples or bubbles. Shearing of fibers, slits in fabric, or driven spikes to relieve such defects will not be permitted.

G. The infill is to be approved by the Supplier and will be inserted according to the Supplier's approved procedures by qualified installers.

H. The bristles of any brooms used, either during the original installation, or in subsequent maintenance, shall be of nylon only, shall under no circumstances include any metal, and must be approved by the Supplier.

I. Installation Limitations

1. Installation shall not proceed when:
    a. Ambient air temperature is below forty (40°) degrees Fahrenheit (F).
    b. Material temperature is below forty (40°) degrees Fahrenheit (F).
    c. Rain is falling or pending, unless acceptable to qualified installers.
2. Conditions exist, or are pending, that will be unsuitable for the installation of the system.

J. Synthetic field lines shall be Inlaid or Tufted as follows:

1. Tufted / Inlaid lining for all sports shall be four (4") inches in width, unless noted otherwise, and colored as follows:
    a. Football - tufted/inlaid - white

b. Soccer - tufted/inlaid – yellow
c. Men's Lacrosse – tufted/inlaid – blue
d. Women's Lacrosse – tufted/inlaid – red

3.5 PROTECTION

A. Installer shall advise the Contractor of procedures required for protection and maintenance of finished synthetic field surfacing during remainder of construction period so that surfacing will be undamaged at time of acceptance.

B. Upon completion of the synthetic field surface, the General Contractor shall be responsible for protection of the field surface for the remainder of the Contract, unless the Owner takes beneficial occupancy prior to contract completion.

END OF SECTION 32 18 23

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. Mechanical seeding or Hydroseeding
2. Seeded Athletic Fields Lawn

B. Related Requirements:

1. Section 01 78 30 “Warranties and Bonds - CMR” for warranty requirements applicable to the work of this Section.
2. Section 32 93 00 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 32 91 15 "Soil Preparation (Performance Specification)" and drawing designations for planting soils.

E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 SUBMITTALS

A. Qualification Data: For landscape Installer.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, 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.

C. Product Certificates: For fertilizers, from manufacturer.

D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

E. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.

2. Experience: Five years' experience in turf installation.

3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

a. Landscape Industry Certified Technician - Exterior.

b. Landscape Industry Certified Lawncare Manager.

c. Landscape Industry Certified Lawncare Technician.

5. Pesticide Applicator: State licensed, commercial.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Accompany each delivery of bulk materials with appropriate certificates.

1.8 FIELD CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: April 1 to June 1.

2. Fall Planting: August 15 to October 1.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.9 WARRANTY

A. Special Warranty: Installer agrees to repair or replace areas of turf that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Unsatisfactory Seeded Turf: unhealthy, non-uniform, loose stand of grass with weeds and surface irregularities, with coverage of less than 90 percent over any 0.92 sq. m (10 sq. ft.) and bare spots exceeding 125 by 125 mm (5 by 5 inches).

2. Warranty Period:

a. Satisfactory Seeded Lawn Turf: As specified in Section 017830 “Warranties and Bonds,” warranty period to commence on Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SEEDED LAWN

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species:

1. Quality: State-certified seed of grass species as listed below for solar exposure.

2. Quality: Seed of grass species as listed below for solar exposure, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:

3. Proportioned by weight as follows:

a. 20 percent Metolius Perennial Ryegrass (endophyte-enhanced).

b. 20 percent Line Drive II Perennial Ryegrass (endophyte-enhanced).

c. 10 percent Deschutes Perennial Ryegrass (endophyte-enhanced).

d. 20 percent Ashland Kentucky Bluegrass.

e. 20 percent Baron Kentucky Bluegrass.

f. 10 percent Rockstar Kentucky Bluegrass.

2.2 FERTILIZERS

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 formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.3 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

B. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

C. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.4 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.

2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.

3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.

2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 SEEDED AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to Section 32 91 15 "Soil Preparation (Performance Specification)."

B. Placing Planting Soil: Place and mix planting soil in place over exposed subgrade or place manufactured planting soil over exposed subgrade.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 SEEDING

A. Seeding may be applied through either mechanical or hydroseeding methods as indicated below.

B. Follow application rates and methods as recommended by the seed mix manufacturer.

3.5 MECHANICAL SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 8 km/h (5 mph).

1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

2. Do not use wet seed or seed that is moldy or otherwise damaged.

3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate as recommended by the seed distributor.

C. Rake seed lightly into top 3 mm (1/8 inch) of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets stapled according to manufacturer's written instructions.

E. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.

F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 42 kg/92.9 sq. m (2 tons/acre) to form a continuous blanket 38 mm (1-1/2 inches) in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.

3.6 HYDROSEEDING

A. Hydroseeding: Mix specified seed, commercial fertilizer (seeded lawn only), and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Mix slurry with nonasphaltic fiber-mulch manufacturer's recommended tackifier.

2. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 15.6-kg/92.9 sq. m (1500-lb/acre) dry weight, and seed component is deposited at not less than the specified seed-sowing rate.

3.7 SEEDED LAWN TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.

2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.

3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 100 mm (4 inches).

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

2. Water turf with fine spray at a minimum rate of 25 mm (1 inch) per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third 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 the following grass height:

1. Mow to a height of 38 to 50 mm (1-1/2 to 2 inches).

D. Turf Postfertilization: Apply commercial fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that provides actual nitrogen of at least 0.45 kg/92.9 sq. m (1 lb/1000 sq. ft.) to turf area.

3.8 SATISFACTORY SEEDED LAWN TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 0.92 sq. m (10 sq. ft.) and bare spots not exceeding 125 by 125 mm (5 by 5 inches).

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.9 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.10 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

3.11 MAINTENANCE SERVICE

A. Seeded Lawn Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

1. Seeded Turf: Eighteen (18) months from date of Substantial Completion.

    a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

END OF SECTION 32 18 24

ISSUED for BID

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. The work under this section applies to the installation of asphalt track paving as well as a new, one-half (1/2") inch base-mat structural spray, urethane track system and all associated work.

B. Install a porous polyurethane synthetic track system, comprised of a base layer of polyurethane-bound SBR granules and topped with a single-component polyurethane structural spray, and EPDM granules.

C. Layout and paint all track lines and event markings, as required and specified by current NFHS & CIAC rules.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirement shall govern.

1. American Association of State Highway and Transportation Officials (AASHTO)
2. American Society for Testing and Materials (ASTM):
3. NFHS – National Federation of State High School Athletic Associations
4. CIAC – Connecticut Interscholastic Athletic Association
5. ASBA – American Sports Builders Association Running Tracks: A Construction and Maintenance Manual
6. Connecticut Department of Transportation (CTDOT).

B. Codes and standards follow the current guidelines set forth by the National Federation of High School Athletic Associations (NFHS) and the Connecticut Interscholastic Athletic Association (CIAC), along with the current material testing guidelines as published by the American Society of Testing and Materials (ASTM), and the American Sports Builders Association (ASBA) Track Construction Manual.

1.4 SITE CONDTIONS

A. The synthetic surfacing contractor shall coordinate the work specified with an authorized and appointed representative of the Owner so as to perform the work during a period and in a manner acceptable to the Owner.

B. The curing time for the asphalt base shall be a minimum of 21 days. Resilient surfacing shall not be installed prior to specified asphalt cure period, unless previously approved in writing by the engineer. It shall be the responsibility of the surfacing contractor to determine if the asphalt substrate has cured sufficiently prior to the application of the polyurethane surfacing system.

C. Resilient surfacing or binders shall not be installed unless the temperature is fifty degrees Fahrenheit and rising. Installation shall be executed only in fully dry conditions.

1.5 SYNTHETIC TRACK SURFACE INSTALLER QUALIFICATIONS

A. The synthetic track surface installer shall have a minimum of 5 years of experience of successfully installing basemat/structural spray running tracks and shall have installed a minimum of 8 complete polyurethane running track surfacing systems, including those requiring a structural spray in New England within the past 5 years.

B. The synthetic track surface installer shall be able to furnish evidence that they have been in business for a period of not less than 5 years, under the present name and, if required, furnish financial statements for each of the past three (3) years.

C. The synthetic track surface installer must be a member of the American Sports Builders Association (ASBA) and must employ a Certified Track Builder (CTB), as approved by ASBA, who will supervise the surface installation.

D. The synthetic track surfacing manufacturer shall provide evidence indicating that the specified materials have been successfully utilized on work of similar scope to that shown and specified for this Project. The synthetic track surfacing examples cited shall have been completed and in use for five years, without any evidence of failure.

E. Synthetic track surface manufacturer shall provide certification that all materials utilized are designated as “mercury and heavy-metals-free”.

F. Synthetic surfacing work shall be done only after excavation and construction work, which might injure the new surface, has been completed. Damage caused during construction shall be repaired to the Owner’s full satisfaction before acceptance.

G. Existing areas shall, if damaged or removed during the construction of this project, be repaired or replaced at no extra cost to the Owner. Workmanship and materials for such repair and/or replacement, unless otherwise noted, shall match as closely as possible to those employed in the existing work.

H. The synthetic surfacing contractor shall take precautionary measures to prevent track surfacing material from staining or coating other surfaces. Staining and coating damage shall be cleaned, removed or repaired to original condition by the synthetic surfacing contractor, to the Owner’s full satisfaction.

I. Thickness of the finished system shall be one half inch (1/2”). Thickness value shall not be determined to the very top of the surface crumb or texture, but to a point somewhat below that, as laid down in a precise method of test.

1.6 SUBMITTALS

A. Standard printed specifications of the resilient track surfacing system, or its equal, to be installed on this project.

B. An affidavit attesting that the resilient track surfacing system to be installed meets the requirements defined by the manufacturer’s currently published specifications and any modifications outlined in those technical specifications.

C. A synthetic track surfacing system sample, 4” x 4” in size, of the same synthetic track surfacing system to be installed on this project.

D. An installation list of outdoor track facilities installed by the designated installer in the last two (2) years, using the exact synthetic track surfacing system specified herein.

E. Other materials and certifications as called out in section 3.1.

F. After completion of the work of this Section, a licensed professional engineer, registered land surveyor or (ASBA) certified track builder shall furnish an acceptable certificate of accuracy of all track markings and measurements.

1.7 WARRANTY

A. Refer to Section 017830 "Warranties and Bonds – CMR".

B. The Tracking Surfacing System shall be fully guaranteed against faulty workmanship and material failure for a period of five (5) years from the date of acceptance. The warranty coverage shall not be prorated, nor limited by the amount of usage. It shall cover (but not be limited to) exercise wear, fading, blistering and delamination.

C. Synthetic surfacing material found to be defective as a result of faulty workmanship and/or material failure shall be replaced or repaired, to the Owner's full satisfaction and at no charge, upon written notification within the guarantee period.

PART 2 - MATERIALS

2.1 ASPHALT TRACK PAVING

A. Asphalt for track surface paving shall comply with the requirements of specification section 32 1216 Asphalt Paving except for the following:

Bituminous Design mix for Track Pavements:

- RAP – Recycled Asphalt content shall NOT be used in the design mix.
- Percent Asphalt by weight shall be 6.5 to 7% by weight (+/- 0.5%) for surface courses 6.0 to 6.5% by weight (+/- 0.5%) for binder courses

B. Grading tolerances for the Asphalt running track are revised as noted in Part 3 of this specification section

2.2 RESILIENT TRACK SURFACING

A. Resilient track surfacing shall be a paved in place, ½" thick synthetic, porous, polyurethane system intended for use on competitive running tracks, comprised of a base layer of polyurethane-bound SBR granules and topped with a single-component polyurethane structural spray, and EPDM granules.

B. The installed resilient track surfacing system shall exhibit the following minimum performance standards (ASTM):

• Thickness:	½" (13mm) or as specified
• Shore A Hardness:	55 ± 5 (ASTM D-2240)
• Elongation at Break:	90% (ASTM D-412)
• Tensile Strength:	0.75 N/mm2 (ASTM D-412)
• Compression Set Recovery:	~90%-95% over 24 hr period (ASTM D-412)
• Abrasion Resistance:	0.25 grams loss after 1000 cycles (ASTM D-501)
• Coefficient of Friction	Dry: 0.7-0.75, Wet: 0.6-0.65 (ASTM D-1984)
• Resilience:	37%-39% (ASTM D-2632)
• Tear Resistance:	50-65 psi (ASTM D-624)
• Color	As shown on plan

2.3 PRIMERS

A. Primers shall be polyurethane-based primer specifically formulated to be compatible with the paved-in-place SBR granules.

2.4 BLACK SBR GRANULES

A. The rubber granules for the base mat shall be recycled SBR rubber, processed and chopped to 1-3mm size, containing less than 4% dust, and no metals.

2.5 EPDM GRANULES

A. The rubber granules for the structural spray, wearing coats shall be EPDM, peroxide-cured, synthetic rubber, containing a minimum 20% EPDM resin, with a specific gravity of 1.5 ±0.1 g/cm3. The EPDM rubber shall be the same color chosen by the Owner for the track surface.

2.6 POLYURETHANE BINDER

A. Binder for the black mat shall be an MDI-based single-component, polyurethane binding agent. The binder shall not have a free TDI monomer level above 0.2%, must be clear in color, and must be solvent free. The binder must be specially formulated for compatibility with SBR rubber crumb.

2.7 STRUCTURAL SPRAY COATING

A. The spray coating shall be an MDI-based single-component, moisture cured, 100% solids, pigmented polyurethane, specifically formulated for compatibility with EPDM granules. The coating shall be the color specified by the Owner. Pigment integrated in the field shall not be allowed.

PART 3 - EXECUTION

3.1 RUNNING TRACK BASE

A. The Resilient track surface shall be laid on an approved subbase and a bituminous asphalt mat, a minimum of three inches (3”) in thickness. The General Contractor shall provide compaction test results of 95% or greater for the installed subbase and asphalt surface.

B. Special care shall be taken during the paving process to insure smooth and imperceptible joints, blending asphalt uniformly to achieve a continuous surface. Infra-red heating devices shall be employed when temperature of material in place falls below 150d F.

C. The track surface, i.e., asphalt substrate, shall not vary under a 10’ straight edge more than 1/8”.

D. It is the responsibility of the asphalt-paving contractor to flood the surface with water immediately after the asphalt is capable of handling traffic, and within 24 hours of installation. If, after 20 minutes of drying time, there are birdbaths (depressions deeper than 1/8”) evident, it shall be the responsibility of the General Contractor, in conjunction with the surfacing contractor to determine the method of correction, subject to the engineer’s approval. Cold tar patching, skin patching or sand mix patching IS NOT an acceptable means of correction.

E. Any oil spills (hydraulic, diesel, motor oil, etc.) shall be completely removed, either by chipping out or removing and replacing with new, keyed in asphalt. The minimum depth of any asphalt replacement shall be one inch. The curing time for the asphalt base is 21 days. It shall be the

responsibility of the surfacing contractor to determine if the asphalt substrate has cured sufficiently prior to the application of the polyurethane surfacing system.

F. It shall be the responsibility of the general contractor to determine if the asphalt substrate meets all design specifications; i.e., cross slopes, planarity and specific project criteria. After all the above conditions are met, the synthetic surfacing contractor must, in writing, accept the planarity of the asphalt receiving base before installation of the resilient surfacing can commence.

G. Start of synthetic track surface application shall constitute sub contractor's acceptance of the asphaltic concrete surface to receive synthetic track surfacing.

3.2 SITE CONDITIONS

A. Installation shall not take place if adjacent or concurrent construction generates excessive dust, abrasives or any other by-product that, in the opinion of the installer, would be harmful to the track material, until completion of such works.

B. Installation shall not occur if wind conditions will cause blowing or migration of over-spray off site, or potentially damage adjacent features. The contractor is responsible for any damage on or off-site directly related to the migration of overspray of the resilient track surfacing.

C. Resilient surfacing or binders shall not be installed unless the temperature is fifty degrees Fahrenheit and rising. Installation shall be executed only in fully dry conditions.

D. If, in the opinion of the installer of the synthetic material, the weather and/or climatic conditions are detrimental to the proper installation of the surfacing materials, work shall be delayed until conditions are acceptable.

3.3 EQUIPMENT

A. The resilient track surfacing components shall be processed and installed by specially designed machinery and equipment. A mechanically operated paver, with variable regulated speed and thermostatically controlled screed, shall be used in the installation of the base mat, utilizing continuous and computerized mixing. The wearing course shall be installed using automatic electronic portioning, which provides continuous mixing and feeding for an accurate, quality controlled installation.

3.4 INSTALLATION

A. Resilient Base Course: The SBR granules and binders shall be mixed together on site to regulate the ratio/quantity of SBR, not to exceed 82% in the base mat portion of the system. The single component polyurethane binder shall be mixed with the SBR rubber so that a minimum of 20%, by weight, exists in the final mixture. This mixture is then mechanically installed using the paver machine.

B. Resilient Wearing Course (a/k/a Color Coat): The 0.5 to 1.5 millimeter EPDM granules shall be mixed with the single-component structural spray coating. The structural spray shall be made in two (2) uniform applications.

3.5 TRACK STRIPING

A. Line and event markings shall be applied by experienced personnel utilizing Acrylic based paint compatible with the synthetic track surfacing. All marking dimensions shall be certified in accordance with the specifications issued and by Section 32 1837 Track Line-Marking.

B. Provide adequate barricades or other protective methods in order to prevent traffic over newly painted areas.

END OF SECTION 32 18 33

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 DESCRIPTION

A. This section pertains to the application of all line marking on the resilient running track surface. The Contractor shall provide all track event marking required by the Connecticut Interscholastic Athletic Conference (CIAC), the American Sports Builder's Association (ASBA) and the National Federation of High School Standards (NFHS).

1.3 QUALITY CONTROL

A. Submittals: The Contractor will prepare and submit for approval a colored track striping and marking plan shop drawing indicating all lane and event markings for approval prior to commencing this phase of the work.

B. Provide specific manufacturers product data for all types of paints and overlays to be used in running track lane marking.

C. The Contractor is responsible for the removal or correction of any overspray, spill or marking not in compliance with applicable track layout.

1.4 WARRANTY

A. As specified in Section 017830 "Warranties and Bond – CMR".

PART 2 – MATERIALS

2.1 PRODUCTS

A. 100% Acrylic Line paint shall be as approved and recommended by the approved resilient track surfacing manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prior to performing any striping work, the striping contractor shall meet with the Owner and the Engineer/Landscape Architect to discuss and approve the striping layout.

B. The Contractor shall provide all labor, materials and equipment necessary to perform the following:

1. Locate and establish radius points.
2. Establish and set all necessary control points.
3. Lay out all lines and marking to within a one-half inch (1/2") (plus only) tolerance according to the markings layout shown on the plans.

4. Prepare all necessary shop drawings.
5. Provide all computations and measurements in organized form.
6. Establish all locations on the curves.
7. Identify all markings, where appropriate, by painting the identification directly onto the track surface in four (4)" letters just below or in front of each mark in the right hand portion of the lane.
8. Paint all of the large three (3) foot high lane numbers in two (2) colors (shadowed backgrounds). Colors to be determined by Owner upon awarding of Contract.
9. All lines shall receive sufficient paint to assure complete opacity and uniformity of color.
10. Paints shall be used directly from original containers and thinned according to the manufacturers written instructions.
11. Paint application rate shall be as recommended by manufacturer.
12. All measurements shall be made by competent, experienced and fully qualified personnel.
13. The paint used shall be line paint made specifically for painting athletic running tracks.
14. The markings shall include all events and marks required or recommended by all local and national associations (whichever governing body is appropriate), including all hurdle and acceleration marks.

C. Clean Up: The Contractor shall remove all bags, pallets, plastic or any other items associated with his/her work and leave the site in the same state of cleanliness as it was when he/she arrived.

END OF SECTION 32 18 37

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. Provide all equipment and materials and installation, of Chain Link fence, line posts, end posts, rails, and gates as designated on the Contract Drawings.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other requirements, the most restrictive requirements shall govern.

1. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
    a. ASTM A 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
    b. ASTM A 123Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
    c. ASTM A 153Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
    d. ASTM A 176(1994) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
    e. ASTM A 385Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
    f. ASTM A 392(1991b) Zinc-Coated Chain-Link Fence Fabric
    g. ASTM A 478(1995a) Chromium-Nickel Stainless and Heat-Resisting Steel Weaving and Knitting Wire
    h. ASTM A 491(1994) Aluminum-Coated Steel Chain-Link Fence Fabric
    i. ASTM A 666(1994) Austenitic Stainless-Steel Sheet, Strip, Plate, and Flat Bar
    j. ASTM C 94 (1994) Ready-Mixed Concrete
    k. ASTM F 626 (1994a) Fence Fittings
    l. ASTM F 688 Poly (Vinyl Chloride) (PVC) and other Organic Polymer-Coated Steel Chain link fence fabric, Class 2B
    m. ASTM F 883 (1990) Padlocks
    n. ASTM F 900 (1994) Industrial and Commercial Swing Gates
    o. ASTM F 1043 (1995) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
    p. ASTM F 1083 (1993) Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded for Fence Structures

2. AMERICAN WELDING SOCIETY (AWS)
   a. AWS WZC (1972) Welding Zinc-Coated Steels
3. CHAIN LINK FENCE MANUFACTURERS INSTITUTE (CLFMI)
   a. CLFMI Product Manual (CLF-PM0610) revised January 2012

1.4 SUBMITTALS

A. Submit shop drawings and manufacturer's specifications and installation instructions for all materials to be used.

B. Certificates: Statement signed by an official authorized to certify on behalf of the manufacturer attesting that the chain link fence and component materials meet the specified requirements.

1.5 WARRANTY

A. As specified in Section 017830 “Warranties and Bonds – CMR”.

PART 2 - PRODUCTS

2.1 CHAIN LINK FENCE MATERIALS

A. Vinyl Coated Fence Fabric
   1. Fabric shall be black vinyl coated thermally fused and bonded to a primer which is thermally cured onto galvanized steel core wire conforming to ASTM F 668, Class 2b. Color of vinyl coating shall be black as specified in the plan set. Minimum coating thickness shall be 0.006 in. Color sample shall be submitted to the Owner for approval.
   2. Chain link Fabric shall be woven into a two (2) inch mesh of 9-core, 8-gauge galvanized wire with a minimum breaking strength of 1290 lbs. In accordance with ASTM F 668, Class 2b.
   3. Zinc for galvanized coating shall conform to ASTM B 6, galvanized by hot dipped method AISI Type I, before vinyl coating; coating shall be smooth. Minimum weight of zinc coating shall be 1.2 oz. per sq. ft.
   4. Polyvinyl chloride coating shall meet the following requirements:
      a. Specific gravity shall be 1.30 maximum, tested in accordance with ASTM D 792.
      b. Hardness shall have a minimum Durometer reading of A 95 in accordance with ASTM D 2240. Ultimate elongation shall be 275% in accordance with ASTM D 412.
   5. Tensile strength shall have a test minimum of 3,300 psi in accordance with ASTM D 412.
   6. Vinyl shall be a dense and impervious covering free of voids, having a smooth, lustrous surface without pinholes, bubbles, voids, or rough or blistered surface.

B. Fence Posts, Hardware, and Fittings - General

1. Fittings shall be of best quality malleable iron castings, wrought iron forgings, or pressed steel and provided with pin connections. Equipment shall be designed to carry 100% overload.
2. Malleable iron castings shall be hot-dipped galvanized in accordance with ASTM A 153.
3. Wrought iron forgings or pressed steel fitting and appurtenances shall be hot-dipped galvanized in accordance with ASTM A 123.
4. Fence Hardware Coatings: shall match fence fabric coating.
5. Piping for fence posts shall be steel conforming to ASTM A 53 except that pipe shall be unthreaded and untested for water pressure.
6. Galvanized items shall be galvanized in accordance with ASTM A 123, A 153, or A 385, as applicable.
7. Bolts, which are installed six (6) feet or less above grade shall not protrude more than 1/4 inch beyond the nut after tightening. Rough edges shall be filed smooth to the satisfaction of the engineer. Peen ends of all bolts after tightening.

C. Posts

1. Under Six Foot (6') High Fence:
   a. Line posts shall be 1.9 in. outside diameter (O.D.), Schedule 40 pipe, weighing 2.28 lb./ft.
   b. End and corner posts shall be 2.375 in. O.D., Schedule 40 pipe, weighing 3.65 lb./ft.
2. Six Feet to Nine Feet (6' to 9') High Fence:
   a. Line posts shall be 2.375 in. O.D., Schedule 40 pipe, weighing 3.65 lb./ft.
   b. End and corner posts shall be 2.875 in. O.D., Schedule 40 pipe, weighing 5.79 lb./ft.
3. Nine Feet to Twelve Feet (9' to 12') High Fence:
   a. Line posts shall be 2.875 in. outside diameter (O.D.), Schedule 40 pipe, weighing 5.79 lb./ft.
   b. End and corner posts shall be 4.00 in. O.D., Schedule 40 pipe, weighing 9.11 lb./ft.
4. Twelve Feet to Sixteen Feet (12' to 16') High Fence:
   a. Line posts shall be 4.0 in. outside diameter (O.D.), Schedule 40 pipe, weighing 9.11 lb./ft.
   b. End and corner posts shall be 6.6 in. O.D., Schedule 40 pipe, weighing 18.9 lb./ft.
5. The gatepost for any gate leaf 6 ft. wide and less shall be 3.0 in. O.D., Schedule 40 pipe, weighing 5.79 lb./ft.
6. Posts shall be PVC coated, thermally fused and bonded to a primer that is thermally cured onto galvanized steel posts. The color of the vinyl coating shall be black. The minimum coating thickness shall be 0.006 in.

D. Rails and Post Braces

1. Top rail, mid rail (**equal to or greater than 8-ft. fence**) and bottom rails shall be 1.66 in. O.D., Schedule 40 pipe, weighing 2.27 lb./ft.

2. Rails and post braces shall be PVC coated, thermally fused and bonded to a primer which is thermally cured onto galvanized steel rails and post braces. The color of the vinyl coating shall be black, as specified in the plan set. The minimum coating thickness shall be 0.006 in.

E. Gates and Gate Frames

1. Fabrication: Assemble gate frames by welding connections. Use the same fabric as for the fence, unless otherwise indicated. Install fabric with stretcher bars at the edges (and tie wire at top and bottom edges, if stretcher is not used). Attach the stretcher bars to gate frame at not more than 12 in. O.C. Attach the hardware with rivets or by other means, which shall provide security against removal or breakage.
    a. Framing:
        1) Fabricate perimeter frames of a minimum of 1.90 in. O.D., Schedule 40 pipe, that has been hot-dipped and galvanized, with a minimum of 2.0 oz. of zinc per sq. ft. of surface area.
    b. Bracing:
        1) Provide diagonal cross bracing, consisting of 3/8 in. diameter adjustable length truss rods, on gates where four-sided tension rods are not used. Provide frame rigidity without sag or twist.
2. Gate hardware: Galvanize per ASTM A 153 (each gate). Provide lockable drop bar on each gate leaf for double swing gates, so that gate leaves can be locked in place individually.
3. Gate Hardware Coatings: These shall match the fence fabric coating.
4. Hinges: Pressed steel or malleable iron to gate size, non-lift-off type, offset to permit 180° gate opening. Provide one pair of hinges for each leaf. Swing gates are to have 180 degree hinges.
5. Latch: Forked type, to permit operation from either side of gate: Provide padlock eye as integral part of latch. Provide locking mechanism for sliding gates.
6. Keeper: Provide keeper for gates, which automatically engages the gate leaf and holds it in the open position until it is manually released.
7. Gates and gate frames shall be PVC coated, thermally fused and bonded to a primer that is thermally cured onto galvanized steel components. The color of the vinyl coating shall be black, as specified in the plan set. The minimum coating thickness shall be 0.006 in.
8. Stretcher Bars
    a. Stretcher bars shall not be less than 3/16 in. x 3/4 in. and shall be the full height of the fabric with which they are being used.
    b. Provide stretcher bars for each gate, end and corner, and pull post stretcher bar bands and clips shall be of heavy pressed steel or malleable iron.

F. Caps

1. Posts shall have caps, which shall be designed to exclude water from the posts. Caps shall have holes suitable for the through passage of the top rail, where necessary.

2. Caps for posts shall be PVC coated, thermally fused and bonded to a primer which is thermally cured onto the galvanized steel caps. The color of the vinyl coating shall be black, as specified in the plan set. The minimum coating thickness shall be 0.006 in. All caps shall be securely fastened to the posts.

G. Tension and Tie Wire

1. PVC Coated Fence: Tie wire shall be 9-gauge O.D., vinyl-clad, galvanized steel wire.

H. Galvanized Paint

1. Cold galvanized paint shall be one of the following:

Product	Manufacturer
Galvicon	Galvicon Corporation
Zinc Shield	Stanley Chemical Division of The Stanley Works

2. Touch-up for Galvanized Surfaces: Touch-up damaged or abraded galvanized surfaces with products equal to one of the following:
   a. Cold Galvanizing Compound; ZRC.
   b. Speedhide Galvanized Steel Paint; PPG.
   c. Series 90-97 Zinc-Rich Primer; Tnemec.

I. Concrete

1. Concrete shall meet ASTM C 94, using 3/4-inch maximum size aggregate, and having minimum compressive strength of 4000 psi at 28 days. Grout shall consist of one-part Portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

PART 3 - EXECUTION

3.1 GENERAL

A. Fence shall be installed to the lines and grades indicated. The area on either side of the fence line shall be cleared to the extent indicated. Line posts shall be spaced equidistant, at intervals not exceeding ten feet (10). Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between the terminal posts. However, runs between terminal posts shall not exceed 500 feet. Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust, in accordance with ASTM A 780.

3.2 POSTS

A. Posts shall be poured-in-place, into the proposed concrete footings, as shown on the plans and details.

3.3 RAILS

A. Top Rail, Mid (8-ft. fence) and Bottom Rails

1. Top, mid (8-ft. fence) and bottom rails shall be supported at each post to form a continuous brace between terminal posts. Where required, sections of top rail shall be joined using sleeves or couplings that shall allow expansion or contraction of the rail. Bottom tension wire is not acceptable.

3.4 BRACES AND TRUSS RODS

A. Braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence furnished. Braces and truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal. No bracing is required on fences six feet high or less, if a top rail is installed.

3.5 CHAIN LINK FABRIC

A. Chain link fabric shall be installed on the playing field side of the fence unless otherwise noted. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall be spaced at approximately fifteen-inch (15") intervals. The fabric shall be installed and pulled taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fabric shall be fastened to line posts at approximately fourteen-inch (14") intervals and fastened to all rails at approximately twelve-inch (12") intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. The top and bottom of installed fabric shall be as indicated on the Drawings. After the fabric installation is complete, the fabric shall be exercised by applying a 50-pound push-pull force at the center of the fabric between posts. The use of a 30-pound pull at the center of the panel shall cause fabric deflection of not more than two- and one-half inches (2-1/2") when pulling fabric from the post side of the fence. Every second fence panel shall meet this requirement. All failed panels shall be re-secured and retested at the Contractor's expense.

3.6 GATES

A. Gates shall be installed plumb, level and secure, at the locations shown. Hinged gates shall be mounted to swing, as indicated. Latches, stops and keepers shall be installed, as required. Slide gates shall be installed as recommended by the manufacturer. Hinge pins and hardware shall be welded or otherwise secured to prevent removal. All gates shall be tested by the Engineer for proper functionality prior to final approval.

3.7 TOUCH-UP

A. Following installation, scratches and marred spots in vinyl-coated surfaces shall be field coated with a vinyl coating supplied by the fence manufacturer.

B. Following installation, scratches and marred spots in galvanized surfaces shall be power wire brushed and painted, with a cold-applied galvanized paint, at a rate of 2 oz. zinc per sq. ft. of surface.

3.8 GROUNDING

A. Electrical equipment attached to the fence shall be grounded, as specified in manufacturer's instructions. Fences shall be grounded on each side of all gates, at each corner, at the closest approach to each building located within 50 feet of the fence, and where the fence alignment changes by more than 15 degrees. Grounding locations shall not exceed 650 feet. Each gate panel shall be bonded with a flexible bond strap to its gatepost. Fences crossed by power lines of 600 volts or more shall be grounded, at or near the point of crossing, and at distances not exceeding 150 feet on each side of crossing. The ground conductor shall consist of No. 8 AWG solid copper wire. Grounding electrodes shall consist of No. 8 AWG solid copper wire. Grounding electrodes shall be ¾ inch, by 10-foot long, copper-clad steel rod. Electrodes shall be driven into the earth so that the top of the electrode is at least six inches below the grade. Where driving is impracticable, electrodes shall be buried a minimum of twelve inches (12") deep and radially from the fence. The top of the electrode shall be not less than two feet or more than eight feet from the fence. The ground conductor shall be clamped to the fence and electrodes with bronze grounding clamps to create electrical continuity between fence posts, fence fabric and ground rods. After installation, the total resistance of the fence to the ground shall not be greater than 25 ohms.

END OF SECTION 32 31 13

ISSUED for BID

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Permafused II™ Polyolefin coated baseball/softball backstops.

1.2 RELATED SECTIONS

A. Section 033000 – "Cast-In-Place Concrete"

B. Section 323113 – "Chain Link Fences and Gates

1.3 SUBMITTALS

A. Shop drawings: Layout of Baseball and Softball Backstops with dimensions, details, and finishes of components, accessories, and post foundations.

B. Product data: Manufacturer's catalog cuts indicating material compliance and specified options.

C. Samples: Color selections for Polyolefin finishes. If requested, samples of materials (e.g., fabric, wires, and accessories).

1.4 SPECIAL WARRANTY

A. Provide Manufacturer's standard limited warranty that its Polyolefin Coated Backstop Chain Link Fence is free from color coating flaking and peeling and other defects in material or workmanship for a period of 15 years from the date of purchase. See Manufacturers Warranty for full details.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Products from qualified manufacturers having a minimum of five years experience manufacturing thermally fused chain link fencing will be acceptable by the architect as equal, approved in writing, ten days prior to bidding, and if they meet the following specifications for design, size gauge of metal parts and fabrication are met.

B. Obtain chain link fences including accessories, fittings, and fastenings, from a single source.

2.2 CHAIN LINK FENCE FABRIC

A. Permafused IITM Polyolefin elastomer coating, 6 mil (0.15 mm) to 10 mil (0.25mm) thickness, thermally fused to zinc-coated steel core wire: Per ASTM F 668 Class 2b. Minimum core wire tensile strength of 75,000 psi (517 MPa).

B. Size: Helically wound and woven to height of 18 feet as indicated on drawings. Roof fabric: 2" (50 mm) diamond mesh of 9 gauge core wire with a diameter of 0.148" (3.76 mm) and a break load of 1290 lbs (5740 N). Color Black ASTM F 934.

Side Fabric: Woven to height of 18 feet [as indicated on drawings with 2" (50 mm) diamond mesh of 6 gauge core wire with a diameter of 0.192' (4.88 mm) and a break load of 2170 lbs (9650 N). Color Black ASTM F 934.

C. Selvage of fabric knuckled at top and knuckled at bottom.

2.3 STEEL FENCE FRAMING

A. Steel pipe - Type I: ASTM F 1083, standard weight schedule 40; minimum yield strength of 30,000 psi (205 MPa); sizes as indicated. Hot-dipped galvanized with minimum average 1.8 oz/ft² (550 g/m²) of coated surface area.

B. Polyolefin Coated finish: In accordance with ASTM F1043, apply supplemental color coating of minimum 10 mils (0.254mm) of thermally fused Polyolefin in Black color.

C. End and Corner Post: 4” od (101.6 mm) 9.11 lbs per/ft (13.6 kg/m) Line (intermediate) Post: 4” od (101.6 mm) 9.11 lbs per/ft (13.6 kg/m)

D. Horizontal rails and roof members 1.9” od (48 mm) 2.72 lbs per/ft (3.65 kg/m)

2.4 POLYOLEFIN COATED ACCESSORIES

A. Chain link fence accessories: ASTM F 626, Provide items required to complete fence system. Galvanize each ferrous metal item in accordance with ASTM A 153 and finished to match framing. Fittings should match manufacturer’s specifications.

B. Post caps: Formed steel or cast malleable iron weather tight closure cap for tubular posts. Provide one cap for each post, except where barbed wire supporting arms are indicated. “C” shaped line post without top rail or barbed wire supporting arms do not require post caps. (Where top rail is used, provide tops to permit passage of top rail.)

C. Top rail and rail ends: Pressed steel per ASTM F626, for connection of rail and brace to posts.

D. Top rail sleeves: (7” (178 mm) expansion sleeve with minimum .137” wire diameter and 1.80” length spring, allowing for expansion and contraction of top rail.

E. Wire ties and clips: 9 gauge [0.148” (3.76 mm)] galvanized steel wire for attachment of fabric to line posts. Double wrap 13 gauge [0.092” (2.324 mm)] for rails and braces. Hog ring ties of 12-1/2 gauge [0.0985” (2.502 mm)] for attachment of fabric to tension wire.

F. Brace and tension (stretcher bar) bands: Pressed steel, minimum 300 degree profile curvature for secure fence post attachment. At square post provide tension bar clips.

G. Tension (stretcher) bars: One piece lengths equal to 2” (50 mm) less than full height of fabric with a minimum cross-section of 3/16” x 3/4” (4.76 mm x 19 mm). Provide tension (stretcher) bars where chain link fabric meets terminal posts.

H. Tension wire: Thermally fused polyolefin applied to zinc coated steel wire: Per ASTM F 1664 Class 2 b, 6 gauge, [0.192” (4.88 mm)] diameter core wire with tensile strength of 75,000 psi (517 MPa).

I. Truss rods & tightener: Steel rods with minimum diameter of 5/16” (7.9 mm). Capable of withstanding a tension of minimum 2,000 lbs.

J. Nuts and bolts are galvanized but not polyolefin coated. Cans of touch up paint are available to color coat nuts and bolts if desired.

2.5 SETTING MATERIALS

A. Concrete: Minimum 28 day compressive strength of 3,000 psi.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify areas to receive fencing are completed to final grades and elevations.

B. Ensure property lines and legal boundaries of work are clearly established.

3.2 CHAIN LINK FENCE FRAMING INSTALLATION

A. Install chain link fence in accordance with ASTM F 567 and manufacturer's instructions.

B. Concrete set all posts: Drill holes in firm, undisturbed or compacted soil. Holes should have a diameter 4 times greater than the outside of post, and depths approximately 6" (150 mm) deeper than post bottom. Excavate deeper as required for adequate support in soft and loose soils, and for posts with heavy lateral loads. Set post bottom 36" (900 mm) below surface when in firm, undisturbed soil. Place concrete around posts in a continuous pour. Trowel finish around post. Slope to direct water away from posts.

C. Check each post for vertical and top alignment, and maintain in position during placement and finishing operations.

D. Rail: Install single lengths between posts.

3.3 CHAIN LINK FABRIC INSTALLATION

A. Fabric: Install fabric on field side, and attach so that fabric remains in tension after pulling force is released. Leave approximately 1" (25 mm) between finish grade and bottom selvage. Attach fabric with wire ties or clips to line posts at 15" (380 mm) on center and to rails, braces, and tension wire at 24" (600 mm) on center.

B. Tension (stretcher) bars: Pull fabric taut; thread tension bar through fabric and attach to terminal posts with bands spaced maximum of 15" (380 mm) on center.

3.4 ACCESSORIES

A. Tie wires: Bend ends of wire to minimize hazard to persons and clothing.

B. Fasteners: Install nuts on side of fence opposite fabric side for added security.

3.5 CLEANING

A. Clean up debris and unused material, and remove from the site.

END OF SECTION 32 31 14

ISSUED for BID

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.

B. Incidental Take Report for *Paspalum laeve* Michx. Ella T. Grasso Technical High School Lower Ballfield Development (date pending).

C. Compensatory Wetland Mitigation Plan and Drawings Ella T. Grasso Technical High School Lower Ballfield Development.

1.2 SUMMARY

A. Section Includes:

1. Threatened plant mitigation.
2. Wetland mitigation.
3. Tree stabilization.
4. Tree-watering devices.

B. The work under this specification shall include the transplantation *of Paspalum laeve* plants into mitigation areas and the relocation of disturbed wetland areas within the locations as depicted on the plans or as directed by the Engineer. During the performance of this work, a qualified conservation horticulturalist must be hired by the contractor and available to visit the site to direct the construction activities involved in mitigation areas. The Contractor shall coordinate with the engineer, architect, and horticulturalist at least 10 days prior to the commencement of these activities to ensure that the needed parties are available.

C. To date, the Federal and State environmental permits for the supplemental bid work have not been granted. These permits relate to flood plain compensation, protection and transplantation of the *Paspalum Laeve* (Beadgrass), invasive species management, and wetland impacts and mitigation.

D. Once the permits are granted the Contractor shall be required to adhere to all requirements of said permits. The Contractor shall immediately notify the Engineer of any questions or clarifications from the stipulated approvals. This project contains numerous environmental concerns. The Contractor(s) shall conduct all operations at the site in full compliance with all permits and to the extent provided by law, and shall be held liable for any violation of the terms and conditions of the permits.

E. The Contractor shall coordinate and fully cooperate with the State Office of Environmental Planning (OEP) for the many environmental aspects of this project. This project contains protected plant species, and wetland mitigation areas requiring strict adhesion to the best management practices as outlined in Section 1.10 of Form 817, the Project Manual, and any permitting special conditions.

F. Protected plant species (wetland and threatened) are present in various areas of the site. The Contractor shall field locate the areas depicted on the drawings and protect all areas with temporary orange construction fencing prior to beginning any work. Work may then commence outside of all temporary fenced areas and/or delineated wetlands.

G. Plant mitigation can only be completed during specific times of the year noted in this specification. The timing of seeding and transplanting are critical to the success of these areas.

H. Related Requirements:

1. Section 01 56 39 - “Temporary Tree and Plant Protection”
2. Section 32 72 01 - “Control and Removal of Invasive Vegetation”
3. Section 32 92 00 - "Turf and Grasses"
4. Section 32 93 00 - “Plants”

1.3 REFERENCE STANDARDS

A. American Nursery and Landscape Association (ANLA).
Ph: (202) 789-2900. Internet: www.anla.org.

1. ANSI Z60.1: American Standard for Nursery Stock (2014).

1.4 COORDINATION

A. Coordination with Architect’s Site Visits: The Architect may elect to be present to observe the execution of the following work. Provide not less than 2 full working days advance notice prior to performing these activities. It will be assumed that any work performed without notifying the Architect of the date and time in advance was performed incompletely or incorrectly.

1. Layout of plant locations.
2. Preparation of planting area subgrades and placement of planting soil.
3. Installation of plants.
4. Application of pre-emergent herbicide upon completion of spring planting.
5. Application of pre-emergent herbicide during Maintenance Period.

B. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 SUBMITTALS

A. Black locust split rail fence and gate shop drawings and product data.

B. Nursery Source Tagging Submittals

1. Nursery Sources: Within 30-days of the Contract start, submit a list of all proposed nursery sources for approval, confirming the availability of plant varieties, sizes, forms, and quantities indicated in the Contract Documents. For field-grown trees and plants specified as “balled and burlapped”, include photographs of the available plant blocks to confirm that the nurseries have a sufficient selection of satisfactory plants available for tagging. Provide the names and telephone numbers for the nurseries’ representatives.

a. Substitutions: Substitutions of plant materials will not be permitted unless approved in writing by the Architect. If any of the specified plants are not available at the time when needed to meet the project schedule, submit a statement documenting the nursery sources investigated and providing proposals for equivalent plants of the nearest available size or similar variety. Substitutions will not be allowed if the Architect identifies alternate nursery sources within a 600 mile radius of the project site.

b. Container-grown plants shall not be substituted for plants designated "B&B" on the Plant List, unless approved in writing by the Architect.

c. Quantities: Quantities shown on the Plant List are for information only. Provide every plant shown on the Drawings. In the event of a discrepancy between the Planting Plans and the written quantities on the Plant List, the Planting Plan shall govern.

2. Planting Schedule: Submit the projected planting schedule, including nursery visits, digging, delivery, storage, and installation dates to the Architect for review and approval. Schedule the dates for each type of landscape work during normal seasons for such work in each area of the site. Correlate with specified maintenance periods to provide maintenance until conclusion of the planting establishment and maintenance period. Revise schedule to keep current, subject to the Architect's approval.

C. Product Data: For each type of product.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.

2. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from multiple angles depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 10 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

a. Field-grown trees and shrubs:

1) Specimen trees: Three photographs of every individual specimen tree, taken from multiple angles.

2) Trees and shrubs to be furnished in quantities of 10 or less: At least three photographs of a typical plant taken from multiple angles, plus photos showing overall views of the blocks from which the trees are to be obtained.

3) Trees and shrubs to be furnished in quantities greater than 10: Photographs of the average plant, the best quality plant, and the worst quality plant, plus photos showing overall views of the blocks from which the trees are to be obtained.

b. Container-grown trees: Three photographs of each individual tree.

c. Container-grown shrubs and vines: One photograph of one typical plant.

d. Perennials and grasses: Photographs are not required.

3. Temporary protective orange construction fencing.

D. Samples for Verification: For each of the following:

1. Organic Mulch: 1-quart volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.

2. Mineral Mulch: 2 lb of each mineral mulch required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on-site; provide an accurate indication of color, texture, and makeup of the material.

3. Slow-Release, Tree-Watering Device: One unit of each size required.

E. Qualification Data: For qualified conservation horticulturalist and landscape Installer. Include list of similar projects completed by both the horticulturalist and Installer demonstrating their capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

F. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.

2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable. For any imported planting soils; refer to the analytical standards in M.13 of the CT DOT Form 817 for general planting of nonacid-loving plants. If in the case imported planting soil is needed for *Paspalum* mitigation (it should not be needed), then the textural class shall be one of the following: very fine sandy loam, loamy fine sand, or sandy clay loam.

G. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project. Manufacturer’s Safety Data Sheets (MSDS).

H. Sample Warranty: For special warranty.

I. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.

1. Experience: Five years' experience in landscape installation in addition to requirements in Section 01 40 00 "Quality Requirements."

2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

3. Pesticide Applicator: State licensed, commercial.

4. Qualified Conservation Horticulturalist supervision.

B. Provide quality, size, genus, species, and variety (hybrids and cultivated varieties are not allowed) of plants indicated, complying with applicable requirements in ANSI Z60.1.

C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.

2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Inspection and Tagging: It is the prerogative of the Architect to inspect and select all plant material at the grower's nursery prior to digging and upon delivery to the project site, for compliance with requirements for genus, species, variety, size, and quality. No cultivars are to be used. Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Plants are subject to inspection and selection for overall form, vigor, and condition by the Architect with the Installer at the nursery source or place of growth. Plants designated as "balled and burlapped" shall be field-grown, and shall not be dug until inspected, approved and sealed by the Architect.

2. The Installer shall accompany the Architect on all source inspections, and shall make all necessary arrangements, provide transportation, and pay all expenses including travel, food, and lodging.

3. Coordinate with approved nurseries and with the Architect to schedule the Architect's nursery visits, to secure approved plants, and to confirm digging and shipping dates in conformance with the approved planting schedule. Arrange nursery visits as far in advance of the scheduled installation as possible, which will typically occur during the period running from September through February preceding the installation. In northern and snow belt nurseries that are expected to become inaccessible during the winter, tagging shall be scheduled for completion prior to the onset of winter conditions. All tagging shall be completed by February 28. Summer and fall digging of deciduous plants will not be permitted without the Architect/Engineer and horticulturalist's approval.

4. All plants shall be delivered to the site with the Architect's permanent seals intact.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Paspalum Planting Restrictions: Paspalum plants must be planted in April, regardless of frost dates to ensure that the disturbed plants are relocated before they begin to grow vigorously.

C. Wetland Mitigation Planting Restrictions: Wetland plants should be planted after the last frost date in Groton Connecticut (estimated to be May 20th) and before the first frost at the end of the growing season for the same area (estimated to be October 11th). Coordinate planting periods with maintenance periods to provide required maintenance from date of Preliminary Acceptance. Planting shall progress only under favorable weather conditions and will not be permitted when the ground is frozen or excessively moist.

1. If special conditions exist to justify a variance in the above planting dates, submit a written request to the Architect stating the special conditions and the proposed variance. Describe techniques in addition to those specified herein that will be employed to prevent dieback and mortality. No waiver of the plant guaranty will be granted for planting performed out-of-season.

D. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements. Do not broadcast seed by mechanical application when the wind velocity is such to prevent uniform seed distribution.

E. Watering: The Installer shall bear sole responsibility for the furnishing and application of all irrigation water, irrespective of whether or not an irrigation system is installed or operable. The Installer shall ensure that all irrigation water is applied at the proper frequency, coverage and in the proper amounts to fulfill the plant establishment and maintenance requirements of the Contract. The Installer's responsibility for all watering shall begin upon delivery of plants to the site, and shall continue through the end of the Warranty period. The Contractor shall be responsible for repairing and reseeding any rills or furrows caused by overwatering at the Contractor's own expense.

1. If no irrigation system is available, or if an available irrigation system is unsatisfactory to the Contractor's needs, then the Installer shall furnish and apply all irrigation water.
2. If an existing irrigation system is made available for the Installer's use, and if the Installer elects to utilize this irrigation system; then the Installer shall accept total responsibility for ensuring that the system is satisfactorily adjusted and operated while utilized by the Installer.
3. If an irrigation system is to be provided or design/built under this Contract, and if the Installer elects to utilize this irrigation system; then the Installer shall coordinate with the irrigation designer, installer and operator, and shall accept total responsibility for ensuring that the system is satisfactorily adjusted and operated while utilized by the Installer.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. *Paspalum laeve*

1. Topsoil: Topsoil shall meet the requirements of Article M.13.01 – Topsoil amended as follows:

   Delete the last paragraph, "When topsoil is … shall meet the above specifications", and add the following:

   Topsoil in the *Paspalum* transplant and seeding areas should meet the following chemical and physical criteria:

   a. True pH of the topsoil should be within the range of 5.6 to 6.5;
   b. Soil texture should meet the USDA Textural Class of very fine sandy loam, or sandy clay loam;
   c. Organic matter content on ignition should be within the range of 1.8 to 2.5 percent.

2. Planting Stock: The Contractor shall provide *Paspalum laeve* planting stock which will be obtained from, and thus transplanted from, existing on-site areas within the proposed development in accordance with the specified methodologies provided in the Incidental Take Report (ITR). A copy of the ITR will be made available to the Contractor.

3. Signage demarcating the *Paspalum laeve* mitigation area must be installed to notify the public that the mitigation site is a conservation area established and protected by state statute. The signs must identify the statute and provide a contact number to direct inquiries or a link to a website where the public can find further information. The sign will not identify the listed plant species as being present in the mitigation area. Provide 1 sign at each mitigation area's gate. Sign size to be designated by the engineer.

B. Refer to the following table for 'Wetland A' mitigation woody plantings:

Scientific Name	Common Name	Size	Indicator Status	Spacing	Notes
Shrubs					
Sambucus nigra ssp. canadensis	Black Elderberry	24-36" Ht. B.B.	FACW	5 ft. on center	Noted growing on site.
Cornus ammomum	Silky Dogwood	24-36" Ht. B.B.	FACW	5 ft. on center	Noted growing on site; provides for bank stabilization.
Alnus incana	Speckled Alder	24-36" Ht. B.B.	FACW	6 ft. on center	Will grow 15+ ft. tall.
Clethra alnifolia	Sweet Pepperbush	24-36" Ht. B.B.	FAC	5 ft. on center	Spreads naturally; good wildlife cover and pollinator source.
Trees					
Quercus palustris	Pin Oak	4-6' Ht. B.B.	FACW	30-40 ft. on center	Noted growing on site
Salix nigra	Black Willow	3-4' Ht. B.B.	FACW	15-20 ft. on center	Keep away from underground utilities.
Nyssa sylvatica	Black Gum/Tupelo	3-4' Ht. B.B.	FAC	45 ft. on center	Soft mass relished by avifauna.

*'Wetland B' shall not have any woody plantings in its' designated mitigation area.

C. Refer to Section 32 92 00 "Turfs and Grasses" for herbaceous conservation mix product (Wetland A and Wetland B mitigation).

D. General: Furnish nursery-grown plants true to genus, species, variety, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning within the last 2 years. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement. No cultivars shall be used.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.

2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

3. Plants shall have been grown under climatic conditions similar to those of the project site.

4. Balled and burlapped plants shall be moved as solid units having firm natural balls of soil of sufficient size to encompass the fibrous and feeding root system to ensure full and prompt plant recovery. Plants with loose, manufactured, cracked, broken, or undersized balls will be rejected.

E. Form and Structure: Unless indicated otherwise in Plant List shown on Drawings, deciduous and evergreen trees shall comply with the following:

1. Habit of growth shall be typical of the species or variety, heavy, symmetrical, well branched and proportioned, and densely foliated when in leaf.

2. Trees shall have a single, relatively straight vertical trunk and central leader. Deciduous shade trees shall be free of major branches up to a height of at least 6-feet unless otherwise specified. Evergreen and clump-form trees shall have dense, compact growth branched to the ground unless otherwise specified.

3. Trees shall be free of codominant stems and vigorous, upright branches that compete with the central leader. If the original leader has been headed, a new leader at least one-half of the diameter of the original leader shall be present.

4. Main branches shall be well-distributed along the central leader, and not clustered together. They shall form a balanced crown appropriate for the species.

5. Branch diameter shall be no larger than two-thirds (one-half is preferred) the diameter of the central leader measured 1 inch above the branch.

6. The attachment of the largest branches (scaffold branches) shall be free of included bark.

F. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

G. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

H. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Hybrids and cultivars are not allowed in mitigation sites.

I. Orientation Mark: Mark field-grown deciduous trees to indicate their north orientation as grown in the nursery. Place a 1-inch diameter spot of white paint on the north side of the trunk within the bottom 12-inches of the trunk.

J. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

2.2 FERTILIZERS

A. Planting Tablets or spikes: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet or spike form. Tablets or spikes shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.3 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Double-shredded softwood bark composed primarily of pine and spruce bark, un-dyed and aged not less than 9 months. Clean and free of foreign matter and disease. Sample to be approved. Care should be taken to ensure that it does not contain propagules of invasive species. Do not mulch in areas that may be inundated by floodwaters.

2. Color: natural, un-dyed.

2.4 PESTICIDES

A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.5 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:

1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.

2.6 MISCELLANEOUS PRODUCTS

A. All *Paspalum* areas must be delineated and protected by temporary orange construction fencing (installation shall be similar to tree protection details, see specification 01 56 39 for additional info.) for the duration of the project prior to any work being done on site. Contractor shall adjust the temporary orange construction fencing limits to encompass existing/transplanted *Paspalum* areas. Temporary construction fencing shall remain in place around plants to remain in place for

duration of Lower Field construction, or until black locust split rail fence is installed in locations shown on the drawings.

B. Wood Pressure-Preservative Treatment: AWPA U1, Use Category UC4a; acceptable to authorities having jurisdiction, and containing no arsenic or chromium.

C. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

D. Burlap: Non-synthetic, biodegradable.

E. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per 0.45 kg (lb) of vesicular-arbuscular mycorrhizal fungi and 95 million spores per 0.45 kg (lb) of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

F. Free-Draining Material: Sand, gravel, stone or mixtures thereof, with not more than 70 percent by weight passing the No. 40 mesh sieve and not more than 10 percent by weight passing the No. 200 sieve.

G. Deer Repellant: Commercial product with documented deer-deterrent properties.

2.7 TOPSOIL & ORGANIC AMENDMENTS (WETLAND MITIGATION ONLY)

A. The term topsoil used herein shall mean a soil meeting the soil textural classes established by the USDA Classification System based upon the proportion of sand, silt, and clay size particles after passing a 2 millimeter (mm) sieve and subjected to a particle size analysis.

B. If topsoil needs to be supplemented with organic material, the material must be tested for organic content prior to mixing in order to determine the proper mixture ratios. The following sources are acceptable:

1. Natural Wetland Soil: The top layer of natural wetland soil excavated from impacted wetlands within the project limits or from another approved wetland source. The bottom of this layer shall be defined as the depth at which the soil color and texture changes, indicating the beginning of the subsoil. Each source must be inspected at least 6 months prior to excavation and determined by the Engineer to be free from seeds and roots of invasive species.

2. Compost: Compost shall be a stable, humus-like organic material produced by the biological and biochemical decomposition of source-separated compostable materials, separated at the point of waste generation, that may include, but are not limited to, leaves and yard trimmings, food scraps, food processing residuals, manure and/or other agricultural residuals, forest residues and bark, and soiled or non-recyclable paper. Compost shall not be altered by the addition of materials such as sand, soil, and glass. Compost shall contain no substances toxic to plants and shall not contain more than 0.1 percent by dry mass of man-made foreign matter. Compost shall pose no objectionable odor and shall not closely resemble the raw material from which it was derived.

   a. Compost shall have a minimum organic matter content of 30 percent dry unit weight basis as determined by loss on ignition in accordance with ASTM D 2974.

   b. Compost shall be loose and friable, not dusty, have no visible free water and have a moisture content of 35 - 60 percent in accordance with ASTM D 2974.

c. The particle size of compost shall be 100 percent less than 25 mm in accordance with AASHTO T27 and shall be free of sticks, stones, roots, or other objectionable elongated material larger than 50 mm in greatest dimension.

d. The pH of compost shall be in the range of 5.5 - 8.0. The maturity of the compost shall be tested and reported using the Solvita Compost Maturity Test and must score 6 or higher to be acceptable.

e. The soluble salt content of compost shall not exceed 4.0 mmhos/cm as determined by using a dilution of 1 part compost to 1 part distilled water. Compost may be either commercially packaged or used in bulk form.

f. All compost shall be from Connecticut Department of Energy and Environmental Protection (CT DEEP) regulated, permitted, or approved facilities. All compost material must be environmentally acceptable and must be accompanied by a Materials Certificate and Certified Test Report in accordance with CTDOT Form 817, Section 1.06.07.

g. Pathogens/Metals/Vector Attraction reduction shall meet United States EPA regulations: 40 CFR Part 503 rule, Table 3, page 9392, Vol. 58 No. 32.

h. The Engineer reserves the right to draw samples and perform tests as may be deemed necessary to assure that the material conforms to these specifications.

PART 3 - EXECUTION

3.1 EXAMINATION

A. A qualified conservation horticulturalist must be hired by the contractor to be on-site to supervise transplantation; the preparation of the seeding area, the transplant of soil materials, and the seeding, to ensure compliance with the environmental plans. The Contractor shall submit to the engineer for review and approval a construction schedule and an outline of construction methodologies for the required earthwork, seedbed preparation, seeding, and transplant area according to the general construction sequence and requirements.

B. Examine areas to receive plants, with the installer, and horticulturalist present, for compliance with requirements and conditions affecting installation and performance of the work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid or other chemical constituent has been deposited in soil within a planting area.

2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.

3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.

4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by the Architect/Engineer, and Horticulturalist and replace with new planting soil.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. The Contractor must schedule the seeding in consultation with the engineer, and qualified conservation horticulturalist to coincide with an approved planting season.

B. Prepare planting area prior to *Paspalum* transplantation by removing the densely vegetated sod layer in areas that do not contain existing *Paspalum* plants.

C. Verify and delineate established work limits in the field. The mitigation areas must be delineated and protected by fencing.

D. Identify temporary access, stockpile, and staging locations.

E. Conduct pre-construction field screening in consultation with the engineer, and horticulturalist to confirm listed plant species locations so protective fence and sedimentation and erosion controls may be installed without impacting said listed plant species.

F. Install protective construction fence around existing listed *Paspalum* populations to remain in place for the duration of Lower Field construction.

G. Install temporary sedimentation and erosion control measures.

H. Identify, clear, grade, and stabilize any required haul road(s). Construct haul roads in a manner that avoids disturbance to existing protected grasses.

I. Within the *Paspalum* transplant and wetland mitigation areas, selected (by the Horticulturalist) vegetation shall be cleared and grubbed as shown on the drawings. Invasive vegetation shall be removed prior to transplantation. To prevent competition, all woody plants must be removed from the mitigation areas prior to planting the *Paspalum*.

J. Protect structures, utilities, sidewalks, pavements, turf areas, existing plants, and other facilities from damage caused by planting operations.

K. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

L. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain the Architect, and Horticulturalist's acceptance of layout before excavating or planting. Make adjustments as directed.

1. Plant locations on the drawings are approximate and are to be used only as a guide. Installer shall accurately stakeout plant locations and bed outlines. Do not begin planting excavations until the Architect/Engineer, and the Horticulturalist has approved or adjusted the stakeouts. Prior to installation, modify plant locations within the project site as directed by the Architect/Engineer, and Horticulturalist without additional cost to the Owner.

2. Unless otherwise indicated, massed plantings and rows of shrubs, perennials, and grasses are to be installed in a staggered triangular or diagonal configuration. Straight, square rows will not be accepted.

3.3 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil according to Section 32 91 15 "Soil Preparation (Performance Specification)."

B. Placing Planting Soil: Place prepared planting soil over exposed subgrade.

C. Before planting, obtain the Architect/Engineer, and Horticulturalist's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

D. *Paspalum* plants should be planted no closer than 3 to 6 inches apart.

E. *Paspalum* plants must be planted such that their final elevation must be between elevation nine and eleven.

3.4 EXCAVATION FOR PASPALUM PLANTS

A. Excavate *Paspalum* transplant area to a depth of 10" below proposed finished grade (subgrade) or as directed by the Engineer, and Horticulturalist.

B. Excavate *Paspalum* plants and soil material from areas located on drawing. Each plant must be dug to a depth of at least 8" below the soil surface and out to a radius of 4" from the center of the plant stalks for transplantation.

C. Transplantation of *Paspalum* plants must be done by hand unless mechanical methods are approved via the ITR approval process.

D. Care must be taken to get the whole root mass during transplantation. Note that some plants may have multiple culms (stems).

E. Care must be taken to prevent trampling of existing *Paspalum* plants in the mitigation area.

3.5 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.

1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
2. Excavate approximately three times as wide as ball diameter for stock.
3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
5. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
6. Maintain supervision of excavations during working hours.
7. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
8. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.

B. Continuous Planting Beds for Shrubs:

1. Excavate shrub beds to a minimum depth of 18" with sides sloping inward at a 45-degree angle. Loosen subgrade by dragging with teeth of bucket 3" to 6" deep. Install first lift of planting soil immediately and do not allow loosened subgrade to become compacted.

2. Install planting soil in 2 equal lifts. Compact each lift to a minimum of 75% and a maximum of 82% of Standard Proctor Density. Scarify between lifts by dragging with the teeth of bucket.

3. Excavate circular planting pits in continuous beds after the planting soil has been installed in continuous beds.

C. Backfill Soil: Subsoil and topsoil removed from excavations may not be used as backfill soil unless otherwise indicated.

D. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

1. Hardpan Layer: Drill 6-inch diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

E. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

3.6 TREE, SHRUB, AND VINE PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 3 inches above adjacent finish grades. Set north mark facing north unless otherwise approved by the Architect.

1. Backfill: Planting soil Type 1 or 2.

2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.

3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 25 mm (1 inch) from root tips; do not place tablets in bottom of the hole.

a. Quantity: According to manufacturer's written recommendations.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 3 inches above adjacent finish grades.

1. Backfill: Planting soil Type 1 or 2.

2. Carefully remove root ball from container without damaging root ball or plant.

3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 25 mm (1 inch) from root tips; do not place tablets in bottom of the hole.

    a. Quantity: According to manufacturer's written recommendations.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

6. Apply pre-emergent herbicide to spring-planted plants after soil has settled by packing and irrigation or rainfall, in accordance with the manufacturer's written instructions.

E. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.7 TREE, SHRUB, AND VINE PRUNING

A. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.

1. Remove dead, injured, interfering, objectionable, obstructing, and weak branches. Make clean cuts as close as possible to the trunk or parent branch without cutting into the branch collar or leaving a stub.

B. Do not apply pruning paint to wounds.

3.8 TREE STABILIZATION

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated on Drawings:

1. Upright Staking and Tying: Stake trees of 2- up 5-inch caliper. Use a minimum length required to penetrate at least 12 inches below bottom of backfilled excavation and to extend to the dimension indicated on Drawings above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.

2. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

    a. Attach flags to each guy wire, 30 inches above finish grade.

B. Trunk Stabilization by Staking and Guying: Install trunk stabilization as follows unless otherwise indicated on Drawings.

1. Proprietary Staking and Guying Device: Install staking and guying system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

3.9 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.

B. *Paspalum* plants must be set in the ground such that their entire root mass is buried.

C. *Paspalum* plants must be planted such that their final elevation must be between elevation nine and eleven.

D. *Paspalum* plants should be planted no closer than 6 inches apart.

E. Install Protective fence around existing *Paspalum* plants to remain in place throughout duration of construction. Install Split Rail Fence around completed transplant and seeding areas of relocated *Paspalum* plants as depicted on the plans.

F. Irrigate transplant area and seeding areas weekly or as otherwise directed by the Engineer, and Horticulturalist, during the plant establishment period.

G. Remove temporary sedimentation and erosion control measures. Temporary devices and structures to control erosion and sedimentation in and around the *Paspalum* transplant area shall be disassembled and properly disposed of when directed by the Engineer, and Horticulturalist. Sediment collected by these devices shall be removed and placed in a manner that prevents its erosion and transport to a waterway or wetland.

H. Use planting soil Type 1 or 2 for backfill.

I. Dig holes large enough to allow spreading of roots.

J. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.

K. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

L. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

M. Apply preemergent herbicide to spring-planted plants after soil has settled by packing and irrigation or rainfall, in accordance with the manufacturer's written instructions.

N. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.10 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees and Treelike Shrubs in Turf Areas: Apply organic mulch ring of 2-inch average thickness, with 36-inch radius around trunks or stems. Do not place mulch within 6 inches of trunks or stems.

2. Organic Mulch in Planting Areas: Apply 2-inch average thickness of organic mulch extending 12 inches beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.11 INSTALLING SLOW-RELEASE WATERING DEVICE

A. Provide one device for each tree.

B. Place device on top of the mulch at base of tree stem and fill with water according to manufacturer's written instructions.

3.12 PLANT MAINTENANCE

A. Follow all practices recommended by the qualified conservation horticulturalist for maintenance with *Paspalum* plants and Wetland mitigation plantings.

B. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

C. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

D. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

E. Heavily water woody plants in late fall, after leaf drop and before the ground freezes.

F. If necessary, apply pre-emergent herbicide to planted areas in early spring when the average soil temperature reaches 52 degrees F at one-half inch soil depth. If treatment is unsuccessful and weeds germinate, provide additional pre-emergent treatment after cultivating soil to remove weeds in late spring.

G. Protect plants from deer damage, including regularly monitoring deer activity and timely applications of deer repellents and barriers.

H. Upon Final Acceptance at end of Maintenance Period, remove tree-stabilization devices and planting saucers. Dress with mulch.

3.13 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.14 REPAIR AND REPLACEMENT

A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

END OF SECTION 32 72 00

ISSUED for BID

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Supplementary Conditions, and Division 1 Specification sections, apply to this section.

1.2 SUMMARY

A. This work shall include all materials, labor and equipment necessary for the eradication and removal of unwanted vegetation within the contract limit line and/or as directed by a qualified environmental specialist. The Contractor is responsible for hiring a qualified environmental specialist approved by the Engineer during the performance of this work. A qualified environmental specialist is to designate all invasive vegetation to be removed, including, but not limited to multiflora rose (Rosa multiflora), Porcelainberry (*Ampelopsis brevipedunculata*) Common Mugwort (*Artemisia vulgaris*) Autumn Olive (*Elaeagnus umbellata*), Japanese Honeysuckle (*Lonicera japonica*), Tartarian Honeysuckle (*Lonicera tatarica*), Morrow's Honeysuckle (*Lonicera morrowii*), Japanese Barberry (*Berberis thunbergii*) Winged Euonymus (*Euonymus alatus*), Wineberry (*Rubus phoenicolasius*), Oriental bittersweet (*Celastrus orbiculatus*), Common Reed (*Phragmites australis*), Reed Canary-grass (*Phalaris arundinacea*), Tree of heaven (*Ailanthus altissima*), and any other species designated on the CT Invasive Plant List established by the CT Invasive Plant Working Group found here: https://cipwg.uconn.edu/invasive_plant_list/ (as may be amended from time to time), that the environmental specialist deems a threat to site conservation goals and objectives. All vegetation designated for removal shall be target-treated with an appropriate herbicide as either a foliar spray, or painted stem application. Regardless, all woody invasives will be flush cut and the remaining stubble chemically treated, or removed in its entirety in accordance with the specifications below or as directed by the qualified environmental specialist. Some work will be completed within areas where desirable species are present and will remain, such as within delineated wetlands and conservation areas of the site. The Contractor shall coordinate with the engineer, architect, and environmental specialist at least 10 days prior to the commencement of these activities to ensure that the needed parties are available.

B. Related work:

1. Section 31 23 00 "Earthwork"
2. Section 32 72 00 "Wetland and Rare Plant Mitigation"

1.3 SUBMITTALS

A. The Contractor shall submit for review a detailed Sequence of Construction Plan for all construction that differs from the guidelines set forth in the Contract Documents or if not completely defined in the Contract Documents to allow for Contractor flexibility. Sequence of Construction Plan shall include provisions for Emergency Operations due to weather, or any other site emergency. No work shall be allowed until Sequence of Operations plan is approved by the Owner's Representative and the Engineer.

B. Qualification Data: For environmental specialist. Include list of similar projects completed by the specialist demonstrating their capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All herbicides shall be registered for the species being treated and shall be formulated as applicable for target-species foliar treatment, cut surface or injection applications. Broadcast or uncontrolled spray application will not be permitted.

PART 3 - EXECUTION

3.1 GENERAL

A. The complete removal and eradication of all unwanted vegetation must be initiated at the beginning of construction prior to overall site clearing and grubbing operations unless otherwise indicated in this specification or approved by the qualified environmental specialist. Conduct treatment and removal only at times and under conditions approved by the environmental specialist. Wetland and rare species subpopulations and individual plants must first be marked out on the site prior to invasive vegetation removal, so that they are not impacted by any removal efforts (refer to 327200 “Wetland and Rare Plant Mitigation” for additional information.

B. The Contractor shall submit to Engineer for review and approval a schedule and an outline of construction methodologies for the required control and removal of invasive vegetation for each species to be removed. This schedule and outline shall include the type and concentration of any herbicide to be used. The Contractor shall also fulfill the following requirements: (1) provide proof of Connecticut Department of Environmental Protection licensure for herbicide application; (2) maintain the label for herbicides being used in his/her possession; (3) have proper safety equipment; (4) be prepared to handle chemical spills before they occur; (5) provide qualified environmental specialist 10 day work notice prior to proceeding, so that a member can schedule to be present where appropriate; and (6) conduct all herbicide formulations and applications, including the addition of appropriate surfactants, in strict conformance with the manufacturer's recommendation and per requirements of regulatory agencies. A written record of herbicide application, including the formulation, concentration, area treated, and date for each application will be kept by the commercial applicator and submitted to the Engineer.

C. All vegetation designated for removal shall be either chemically treated with an appropriate herbicide or removed in its entirety to prevent re-sprouting from the roots. Flush cut brush and trees shall not be more than 2 inches above the ground line. Remove all twining vines in treetops to the greatest extent possible without damaging the branches of the supporting desired vegetation. Cut and remove vines overtopping tree canopies. Climbing spikes will not be permitted for aerial work. All cut vegetation shall be chipped separate from other cleared material, and disposed of in accordance with the following stipulations. Invasive species may be buried on site within the contract limit line under a minimum of five feet of cover on all sides for Japanese knotweed (*Polygonum cuspidatum*) and three feet of cover on all sides for all other species or removed from site and disposed of at an approved location as identified in the Contractor's submitted schedule and outline of construction methodologies.

D. Chemically treat all live stems or completely remove root systems of target species. The site will be reevaluated and any re-growth treated prior to the installation of any landscape plantings. The areas of removal shall also be re-evaluated each growing season by the qualified

environmental specialist for a period not less than the calendar days allotted for contract time to determine where repeat herbicide applications and/or further mechanical removal is necessary. Any re-sprouting within this timeframe shall be treated as necessary for eradication.

E. Specifically for Multiflora Rose (*Rosa multiflora*), Autumn Olive (*Elaeagnus umbellata*), Tartarian Honeysuckle (*Lonicera tatarica*), Morrow's Honeysuckle (*Lonicera morrowii*), Japanese Barberry (*Berberis thunbergii*), Winged Euonymus (*Euonymus alatus*), Wineberry (*Rubus phoenicolasius*) and other woody invasive shrubs, the shrubs shall be removed in their entirety to prevent re-sprouting from the roots. Removal shall be conducted in the spring (March 21st through June) before fruit is set in order to avoid further spread. The areas of removal shall be re-evaluated by the qualified environmental specialist throughout the duration of the project to determine if any further grubbing is necessary.

F. Specifically for herbaceous graminids such Common Reed (*Phragmites australis*), and Reed Canary-grass (*Phalaris arundinacea*), treatment shall consist of spraying with a glyphosate treatment (Roundup Pro or approved equivalent) or glufosinate-ammonium (Finale or approved equivalent). For control of broad-leaved herbaceous plants such as Common Mugwort, Japanese Knotweed, etc., a triclopyr-based herbicide shall be useds used.

Depending on the start date of work, spraying shall be conducted in early spring (March 21st through April) after seedlings have emerged but prior to flowering of second-year plants, or as directed by the qualified environmental specialist. This strategy shall be continued for every season that the project remains active.

G. Specifically for Norway Maple (*Acer platanoides*), and Tree of Heaven (*Ailanthus altissima*), the trees shall be cut in spring or summer and stumps shall be treated with undiluted triclopyr (Garlon 3A or approved equivalent). Any re-growth shall be re-treated with triclopyr for the duration of the project.

H. Specifically for Porcelainberry (*Ampelopsis brevipedunculata*), Japanese Honeysuckle (*Lonicera japonica*), Oriental Bittersweet, (*Celastrus orbiculatus*), vines shall be cut and vine stumps treated immediately with a triclopyr treatment (Garon 3A or approved equivalent) in the summer or early fall (June 21 through September). Any re-growth from stumps shall be re-cut and treated for the duration of the project. Tricopry shall be applied directly to small seedlings and root suckered clones without cutting any time between sprouting and the end of September.

I. Legally dispose of all cut trees, brush, cuttings and unchippable material off-site or as designated by the qualified environmental specialist in accordance with above requirements.

J. No equipment or vehicles other than that required to complete the work will be permitted in the areas designated for invasive vegetation removal.

K. Prune out any branches on non-treatment plants that are damaged during removal of vegetation. All corrective pruning shall conform to the National Arborists Association Pruning Standards.

END OF SECTION 32 72 01

ISSUED for BID

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 planting soils specified according to performance requirements of the mixes.

B. Related Requirements:

1. Section 31 10 00 "Site Clearing" for topsoil stripping and stockpiling.
2. Section 32 92 00 "Turf and Grasses" for placing planting soil for turf and grasses.
3. Section 32 93 00 "Plants" for placing planting soil for plantings.

1.3 DEFINITIONS

A. AAPFCO: Association of American Plant Food Control Officials.

B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.

C. CEC: Cation exchange capacity.

D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.

E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.

F. Imported Soil: Soil that is transported to Project site for use.

G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.

H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.

I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.

M. SSSA: Soil Science Society of America.

N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.

Q. USCC: U.S. Composting Council.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 SUBMITTALS

A. Product Data: For each type of product.

1. Include recommendations for application and use.
2. Include test data substantiating that products comply with requirements.
3. Include sieve analyses for aggregate materials.
4. Material Certificates: For each type of imported soil and soil amendment and fertilizer before delivery to the site, according to the following:
    a. Manufacturer's qualified testing agency's certified analysis of standard products.
    b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
    c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

B. Connecticut High Performance Building Submittals:

1. Recycled content materials.
2. Local materials.

C. Samples: For each bulk-supplied material, 4-L (1-gal.) volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

D. Qualification Data: For each testing agency.

E. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.

F. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction soil analyses on existing, on-site soil and imported soil.

1. Notify Architect seven days in advance of the dates and times when laboratory samples will be taken.

B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

1.8 SOIL-SAMPLING REQUIREMENTS

A. General: Extract soil samples according to requirements in this article.

B. Sample Collection and Labeling: Have samples taken and labeled by Contractor in presence of Landscape Architect under the direction of the testing agency.

1. Number and Location of Samples: Minimum of three representative soil samples from varied locations for each soil to be used or amended for landscaping purposes.

2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."

3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.

4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.9 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article.

B. Physical Testing:

1. Soil Texture: Soil-particle, size-distribution analysis by both of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":

a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.

b. Hydrometer Method: Report percentages of sand, silt, and clay.

C. Chemical Testing:

1. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.

D. Fertility Testing: Soil fertility analysis according to standard laboratory protocol of SSSA NAPT NEC-67, including the following:

1. Percentage of organic matter.
2. Soil reaction (acidity/alkalinity pH value).
3. Nitrogen ppm.
4. Phosphorous ppm.
5. Potassium ppm.
6. Manganese ppm.
7. Calcium ppm.
8. Other deleterious materials, including their characteristics and content of each.

E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3-Chemical Methods."

F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.

1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 100 sq. m (1000 sq. ft.) for 150-mm (6-inch)depth of soil.
2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 100 sq. m (1000 sq. ft.) for 150-mm (6-inch)depth of soil.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Do not move or handle materials when they are wet or frozen.
4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.1 PLANTING SOILS SPECIFIED ACCORDING TO PERFORMANCE REQUIREMENTS

A. Planting-Soil Type I: Existing, on-site surface soil, with the duff layer, if any, retained; and stockpiled on-site; modified to produce viable planting soil. Using preconstruction soil analyses

and materials specified in other articles of this Section, amend existing, on-site surface soil to become planting soil complying with the following requirements:

1. Percentage of Organic Matter: 5 to 8 percent by volume.
2. Soil Reaction: pH of 6 to 7.
3. Fertility: N,P, K, Mg, and Ca in amounts recommended by the testing laboratory for the turf types and plant groups to be installed.

B. Planting-Soil Type II: Imported, naturally formed soil from off-site sources and consisting of sandy loam or loam soil according to USDA textures; and modified to produce viable planting soil. Amend imported soil with materials specified in other articles of this Section to become planting soil complying with the following requirements:

1. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches (100 mm) deep, not from bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass.
2. Additional Properties of Imported Soil before Amending: Minimum of 2 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration. Clean soil to be of the following:
    a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
    b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 5 percent by dry weight of the imported soil.
    c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1 1/4 inches in any dimension.
3. Percentage of Organic Matter: Minimum 5 to 8 percent by volume.
4. Soil Reaction: pH of 6 to 7.
5. Fertility: N, P, K, Mg, and Ca in amounts recommended by the testing laboratory for the turf types and plant groups to be installed.

2.2 ORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

1. Percent by weight passing through square mesh sieves:
    a. 100 percent passing No. 10 sieve.
    b. Minimum 90 percent passing No. 20 sieve.
    c. Minimum 40 percent passing No. 100 sieve.
2. Form: Provide lime in form of ground dolomitic limestone.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a 3.35-mm (No. 6) sieve and a maximum of 10 percent passing through a 0.425-mm (No. 40) sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to ASTM C 33/C 33M.

E. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:

1. Feedstock: May include biosolids.
2. Reaction: pH of 5.5 to 8.
3. Soluble-Salt Concentration: Less than 4 dS/m.
4. Moisture Content: 35 to 55 percent by weight.
5. Organic-Matter Content: 40 to 60 percent of dry weight.
6. Particle Size: Minimum of 98 percent passing through a ¾ inch sieve.

2.3 FERTILIZERS

A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

B. 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 formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

PART 3 - EXECUTION

3.1 GENERAL

A. Place planting soil and fertilizers according to requirements in other Specification Sections.

B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

A. Excavation: Excavate soil from designated area(s) to a depth of 150 mm (6 inches) and stockpile until amended.

B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

C. Unsuitable Materials: Clean soil to contain a combined maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.

D. Screening: Pass unamended soil through a 50-mm (2-inch) sieve to remove large materials.

3.3 PLACING PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Subgrade Preparation: Till subgrade to a minimum depth of 100 mm (4 inches). Remove stones larger than 50 mm (2 inches) in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.

1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top 50 mm (2 inches) of subgrade. Spread remainder of planting soil.

C. Compaction: Compact each blended lift of planting soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698.

D. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests and inspections:

1. Performance Testing: For each amended planting-soil type, demonstrating compliance with specified performance requirements. Perform testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.

C. Soil will be considered defective if it does not pass tests.

D. Prepare test reports.

E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.5 PROTECTION

A. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:

1. Storage of construction materials, debris, or excavated material.

2. Parking vehicles or equipment.

3. Vehicle traffic.

4. Foot traffic.

5. Erection of sheds or structures.

6. Impoundment of water.

7. Excavation or other digging unless otherwise indicated.

B. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Architect and replace contaminated planting soil with new planting soil.

3.6 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.

END OF SECTION 32 91 15

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. Mechanical seeding or Hydroseeding
2. Seeded Lawn
3. Basin Erosion Control/Restoration Mix
4. Basin Wetmix

B. Related Requirements:

1. Section 01 78 30 “Warranties and Bonds” for warranty requirements applicable to the work of this Section.
2. Section 32 93 00 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 32 91 15 "Soil Preparation (Performance Specification)" and drawing designations for planting soils.

E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 SUBMITTALS

A. Qualification Data: For landscape Installer.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, 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.

C. Product Certificates: For fertilizers, from manufacturer.

D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

E. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year. Submit before expiration of required maintenance periods.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.

2. Experience: Five years' experience in turf installation.

3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

a. Landscape Industry Certified Technician - Exterior.

b. Landscape Industry Certified Lawncare Manager.

c. Landscape Industry Certified Lawncare Technician.

5. Pesticide Applicator: State licensed, commercial.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Accompany each delivery of bulk materials with appropriate certificates.

1.8 FIELD CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: April 1 to June 1.

2. Fall Planting: August 15 to October 1.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.9 WARRANTY

A. Special Warranty: Installer agrees to repair or replace areas of turf that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Unsatisfactory Seeded Turf: unhealthy, non-uniform, loose stand of grass with weeds and surface irregularities, with coverage of less than 90 percent over any 0.92 sq. m (10 sq. ft.) and bare spots exceeding 125 by 125 mm (5 by 5 inches).

2. Warranty Period:

a. Satisfactory Seeded Lawn Turf: As specified in Section 017830 “Warranties and Bonds,” warranty period to commence on Date of Substantial Completion.

b. Satisfactory Basin Erosion Control/Restoration mix area: As specified in Section 017830 “Warranties and Bonds,” warranty period to commence on Date of Substantial Completion.

c. Satisfactory Basin Wetmix area: As specified in Section 017830 “Warranties and Bonds,” warranty period to commence on Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SEEDED LAWN

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species:

1. Quality: State-certified seed of grass species as listed below for solar exposure.

2. Quality: Seed of grass species as listed below for solar exposure, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:

3. Proportioned by weight as follows:

a. 35 percent Kentucky bluegrass.

b. 35 percent creeping red fescue.

c. 20 percent “Fiesta 4” perennial ryegrass.

d. 10 percent “Express” perennial ryegrass.

2.2 FERTILIZERS

A. Do not use fertilizers on areas to receive Basin Wetmix or Basin Erosion Control/Restoration Mix.

B. 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 formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.3 BASIN EROSION CONTROL/RESTORATION MIX

A. Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species:

1. Quality: Seed of selected native grasses and wildflower species as listed below for solar exposure, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:

2. Species to be included as follows:

a. Elymus virginicus - Virginia Wild Rye

b. Festuca rubra – Creeping Red Fescue

c. Schizachyrium scoparium – Little Bluestem

d. Andropogon gerardii – Big Bluestem

e. Panicum virgatum – Switch Grass

f. Verbena hastate – Blue Vervain

g. Agrostis scabra – Rough Bentgrass

h. Aster novae-angliae – New England Aster

i. Eupatorium maculatum – Spotted Joe Pye weed

j. Eupatorium perfoliatum – Boneset

k. Juncus effuses – Soft Rush

l. Scirpus cyperinus – Wool Grass

2.4 BASIN WETMIX

A. Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species:

1. Quality: Seed of native species as listed below for solar exposure, with not less than 85 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:

2. Species to be included as follows:

a. Carex lurida – Lurid Sedge

b. Carex scoparia – Blunt Broom Sedge

c. Verbena hastate – Blue Vervain

d. Carex lupulina – Hop Sedge

e. Scirpus atrovirens – Green Bulrush

f. Panicum rigidulum – Redtop Panic Grass

g. Deschampsia cespitosa – Tufted Hairgrass

h. Bidens aristosa – Tickseed Sunflower/Bur Marigold

i. Eleocharis palustris – Creeping Spike Rush

j. Juncus effuses – Soft Rush

k. Carex crinite – Fringed Sedge

l. Mimulus ringens – Square Stemmed Monkey Flower

m. Aster punceus – Swamp Aster

n. Eupatorium perfoliatum – Boneset

o. Glyceria Canadensis – Rattlesnake Grass

p. Asclepias incarnate – Swamp Milkweed

q. Helenium autumnale – Common sneezeweed

r. Penthorum sedoides – Ditch Stonecrop

2.5 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

B. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

C. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

2.6 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.3 SEEDED AREA PREPARATION

A. General: Prepare planting area for soil placement and mix planting soil according to Section 32 91 15 "Soil Preparation (Performance Specification)."

B. Placing Planting Soil: Place and mix planting soil in place over exposed subgrade or place manufactured planting soil over exposed subgrade.

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 SEEDING

A. Seeding may be applied through either mechanical or hydroseeding methods as indicated below.

B. Do not include fertilizer in areas to receive Basin Wetmix or Basin Erosion Control/Restoration Mix.

C. Follow application rates and methods as recommended by the seed mix manufacturer.

3.5 MECHANICAL SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 8 km/h (5 mph).

1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
2. Do not use wet seed or seed that is moldy or otherwise damaged.

3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a total rate as recommended by the seed distributor.

C. Rake seed lightly into top 3 mm (1/8 inch) of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with slopes exceeding 1:4 with erosion-control blankets stapled according to manufacturer's written instructions.

E. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.

F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of 42 kg/92.9 sq. m (2 tons/acre) to form a continuous blanket 38 mm (1-1/2 inches) in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.

3.6 HYDROSEEDING

A. Hydroseeding: Mix specified seed, commercial fertilizer (seeded lawn only), and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Mix slurry with nonasphaltic fiber-mulch manufacturer's recommended tackifier.

2. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 15.6-kg/92.9 sq. m (1500-lb/acre) dry weight, and seed component is deposited at not less than the specified seed-sowing rate.

3.7 SEEDED LAWN TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.

2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.

3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 100 mm (4 inches).

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

2. Water turf with fine spray at a minimum rate of 25 mm (1 inch) per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third 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 the following grass height:

1. Mow to a height of 38 to 50 mm (1-1/2 to 2 inches).

D. Turf Postfertilization: Apply commercial fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that provides actual nitrogen of at least 0.45 kg/92.9 sq. m (1 lb/1000 sq. ft.) to turf area.

3.8 SATISFACTORY SEEDED LAWN TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 0.92 sq. m (10 sq. ft.) and bare spots not exceeding 125 by 125 mm (5 by 5 inches).

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.9 BASIN EROSION CONTROL/RESTORATION MIX MAINTENANCE

A. Maintain and establish basin erosion control/restoration mix areas by watering, weeding, replanting, and performing other operations as required to establish a healthy, viable area. Roll, regrade, and replant bare or eroded areas and remulch. Provide materials and installation the same as those used in the original installation.

1. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.

2. Apply treatments as required to keep basin erosion control/restoration mix areas free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and watering equipment to convey water from sources and to keep area uniformly moist.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

2. Water with fine spray at a minimum rate of 1/2 inch per week for six weeks after planting unless rainfall precipitation is adequate.

3.10 BASIN WETMIX MAINTENANCE

A. Maintain and establish basin wetmix areas by watering, weeding, replanting, and performing other operations as required to establish a healthy, viable area. Roll, regrade, and replant bare or eroded areas and remulch. Provide materials and installation the same as those used in the original installation.

1. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.

2. Apply treatments as required to keep basin wetmix areas free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and watering equipment to convey water from sources and to keep area uniformly moist.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.

2. Water with fine spray at a minimum rate of 1/2 inch per week for six weeks after planting unless rainfall precipitation is adequate.

3.11 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.12 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

D. Remove nondegradable erosion-control measures after grass establishment period.

3.13 MAINTENANCE SERVICE

A. Seeded Lawn Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

1. Seeded Turf: Eighteen (18) months from date of Substantial Completion.

a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.

B. Basin Erosion Control/Restoration Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Basin Erosion Control/Restoration Mix maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable area is established, but for not less than the following periods:

1. Basin Erosion Control/Restoration Mix: Eighteen (18) months from date of Substantial Completion.

    a. When initial maintenance period has not elapsed before end of planting season, or if area is not fully established, continue maintenance during next planting season.

C. Basin Wetmix Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Basin Wetmix maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable area is established, but for not less than the following periods:

1. Basin Wetmix: Eighteen (18) months from date of Substantial Completion.

2. When initial maintenance period has not elapsed before end of planting season, or if area is not fully established, continue maintenance during next planting season.

END OF SECTION 32 92 00

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. Plants.
2. Tree stabilization.
3. Tree-watering devices.
4. Landscape edgings.

B. Related Requirements:

1. Division 1 Section 01 78 30 – “Warranties and Bonds” for warranty requirements applicable to the work of this Section.
2. Section 32 92 00 "Turf and Grasses" for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Central Leader: A continuation of the main trunk located more or less in the center of the crown, beginning at the lowest main branch (scaffold) and extending to the top of the tree. Also referred to as the Dominant Leader.

D. Codominant: Two or more vigorous, upright branches or stems of relatively equal size that originate from a common point, usually where the leader was lost or removed.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

F. Crown: The portion of a tree beginning at the lowest main (scaffold) branch extending to the top of the tree.

G. Finish Grade: Elevation of finished surface of planting soil.

H. Included Bark: Bark embedded in the union between a branch and the trunk or between two or more stems that prevents the formation of a normal branch bark ridge.

I. Nursery: A place where young trees and plants are grown commercially for sale. Not included in this definition are horticultural distribution centers and plant re-wholesalers.

J. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.

K. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

L. Planting Area: Areas to be planted.

M. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 32 91 15 "Soil Preparation (Performance Specification)" for drawing designations for planting soils.

N. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

O. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

P. Scaffold Branches: Large main branches that form the main structure of the crown.

Q. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

R. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

S. Trunk: The main stem of a tree, beginning at the root collar and ending at the lowest main scaffold branch.

1.4 REFERENCE STANDARDS

A. American Nursery and Landscape Association (ANLA). Ph: (202) 789-2900. Internet: www.anla.org.

1. ANSI Z60.1: American Standard for Nursery Stock (2014).

1.5 COORDINATION

A. Coordination with Architect's Site Visits: The Architect may elect to be present to observe the execution of the following work. Provide not less than 2 full working days advance notice prior to performing these activities. It will be assumed that any work performed without notifying the Architect of the date and time in advance was performed incompletely or incorrectly.

1. Deliveries of plant materials.
2. Layout of plant locations.
3. Preparation of planting area subgrades and placement of planting soil.
4. Installation of plants.
5. Application of pre-emergent herbicide upon completion of spring planting.
6. Application of pre-emergent herbicide during Maintenance Period.

B. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.6 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.7 SUBMITTALS

A. Nursery Source Tagging Submittals

1. Nursery Sources: Within 30-days of the Contract start, submit a list of all proposed nursery sources for approval, confirming the availability of plant varieties, sizes, forms, and quantities indicated in the Contract Documents. For field-grown trees and plants specified as "balled and burlapped", include photographs of the available plant blocks to confirm that the nurseries have a sufficient selection of satisfactory plants available for tagging. Provide the names and telephone numbers for the nurseries' representatives.

a. Substitutions: Substitutions of plant materials will not be permitted unless approved in writing by the Architect. If any of the specified plants are not available at the time when needed to meet the project schedule, submit a statement documenting the nursery sources investigated and providing proposals for equivalent plants of the nearest available size or similar variety. Substitutions will not be allowed if the Architect identifies alternate nursery sources within a 600 mile radius of the project site.

b. Container-grown plants shall not be substituted for plants designated "B&B" on the Plant List, unless approved in writing by the Architect.

c. Quantities: Quantities shown on the Plant List are for information only. Provide every plant shown on the Drawings. In the event of a discrepancy between the Planting Plans and the written quantities on the Plant List, the Planting Plan shall govern.

2. Planting Schedule: Submit the projected planting schedule, including nursery visits, digging, delivery, storage, and installation dates to the Architect for review and approval. Schedule the dates for each type of landscape work during normal seasons for such work in each area of the site. Correlate with specified maintenance periods to provide maintenance until conclusion of the planting establishment and maintenance period. Revise schedule to keep current, subject to the Architect's approval.

B. Product Data: For each type of product.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.

2. Plant Photographs: Include color photographs in digital format of each required species and size of plant material as it will be furnished to Project. Take photographs from multiple angles depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 10 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify

each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

a. Field-grown trees and shrubs:

1) Specimen trees: Three photographs of every individual specimen tree, taken from multiple angles.

2) Trees and shrubs to be furnished in quantities of 10 or less: At least three photographs of a typical plant taken from multiple angles, plus photos showing overall views of the blocks from which the trees are to be obtained.

3) Trees and shrubs to be furnished in quantities greater than 10: Photographs of the average plant, the best quality plant, and the worst quality plant, plus photos showing overall views of the blocks from which the trees are to be obtained.

b. Container-grown trees: Three photographs of each individual tree.

c. Container-grown shrubs and vines: One photograph of one typical plant.

d. Perennials and grasses: Photographs are not required.

C. Samples for Verification: For each of the following:

1. Organic Mulch: 1-quart volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.

2. Mineral Mulch: 2 lb of each mineral mulch required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on-site; provide an accurate indication of color, texture, and makeup of the material.

3. Slow-Release, Tree-Watering Device: One unit of each size required.

4. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.

5. Tree Grates, Frames, and Accessories: Manufacturer's standard size delivered to site for review, to verify design and color selected.

D. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

E. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:

1. Manufacturer's certified analysis of standard products.

2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

F. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

G. Sample Warranty: For special warranty.

H. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.

1. Experience: Five years' experience in landscape installation in addition to requirements in Section 01 40 00 "Quality Requirements."

2. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

3. Pesticide Applicator: State licensed, commercial.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.

2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Inspection and Tagging: It is the prerogative of the Architect to inspect and select all plant material at the grower’s nursery prior to digging and upon delivery to the project site, for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Plants are subject to inspection and selection for overall form, vigor, and condition by the Architect with the Installer at the nursery source or place of growth. Plants designated as “balled and burlapped” shall be field-grown, and shall not be dug until inspected, approved and sealed by the Architect.

2. The Installer shall accompany the Architect on all source inspections, and shall make all necessary arrangements, provide transportation, and pay all expenses including travel, food, and lodging.

3. Coordinate with approved nurseries and with the Architect to schedule the Architect’s nursery visits, to secure approved plants, and to confirm digging and shipping dates in conformance with the approved planting schedule. Arrange nursery visits as far in advance of the scheduled installation as possible, which will typically occur during the period running from September through February preceding the installation. In northern and snow belt nurseries that are expected to become inaccessible during the winter, tagging shall be scheduled for completion prior to the onset of winter conditions. All tagging shall be completed by February 28. Summer and fall digging of deciduous plants will not be permitted without the Architect’s approval.

4. All plants shall be delivered to the site with the Architect's permanent seals intact.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Accompany each delivery of bulk materials with appropriate certificates.

C. All plants shall be prepared and packed, and protected to ensure arrival at the site in good condition. They shall arrive fresh and properly dug, in sound, healthy, vigorous condition with healthy well-developed tops and root systems, and with all parts moist and showing active green cambium when cut.

D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

E. Handle planting stock by root ball.

F. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.

G. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

H. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

1. Remove all wrapping materials upon delivery to the site or while kept in holding yard.

I. Deliveries shall correspond to the planting schedule to ensure immediate planting. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Set balled stock on ground and cover ball with mulch, or other acceptable material.

2. Do not remove container-grown stock from containers before time of planting.

3. Water root systems of plants stored on-site deeply and thoroughly with a drip irrigation system. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.10 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Preliminary Acceptance. Planting shall progress only under favorable weather conditions and will not be permitted when the ground is frozen or excessively moist.

1. Plant within the following recommended periods to provide optimal conditions for successful recovery from transplanting stresses:

   a. Plant deciduous plants: March 1 to May 15, and October 15 until the ground freezes.

      1) Spring planting may be extended until June 15 if a well-monitored irrigation system is in use.

   b. Plant evergreen plants: April 1 to June 1, and August 15 to October 15.

   c. Perennials and Ornamental Grasses: plant in spring after all danger of frost has passed. Do not plant while ground is still wet or sticky after thawing or heavy from prolonged rain. Complete this work before June 1.

   d. Bulbs: from September 1 until the ground freezes.

2. If special conditions exist to justify a variance in the above planting dates, submit a written request to the Architect stating the special conditions and the proposed variance. Describe techniques in addition to those specified herein that will be employed to prevent dieback and mortality. No waiver of the plant guaranty will be granted for planting performed out-of-season.

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

D. Watering: The Installer shall bear sole responsibility for the furnishing and application of all irrigation water, irrespective of whether or not an irrigation system is installed or operable. The Installer shall ensure that all irrigation water is applied at the proper frequency, coverage and in the proper amounts to fulfill the plant establishment and maintenance requirements of the Contract. The Installer’s responsibility for all watering shall begin upon delivery of plants to the site, and shall continue through the end of the Warranty period.

1. If no irrigation system is available, or if an available irrigation system is unsatisfactory to the Contractor’s needs, then the Installer shall furnish and apply all irrigation water.

2. If an existing irrigation system is made available for the Installer’s use, and if the Installer elects to utilize this irrigation system; then the Installer shall accept total responsibility

for ensuring that the system is satisfactorily adjusted and operated while utilized by the Installer.

3. If an irrigation system is to be provided or design/built under this Contract, and if the Installer elects to utilize this irrigation system; then the Installer shall coordinate with the irrigation designer, installer and operator, and shall accept total responsibility for ensuring that the system is satisfactorily adjusted and operated while utilized by the Installer.

1.11 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Death and unsatisfactory growth.

   b. Structural failures including plantings falling or blowing over.

   c. Faulty performance of tree stabilization and edgings.

   d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Periods: From date of Preliminary Acceptance of planting or upon Substantial Completion of the contract, whichever occurs later.

   a. Trees, Shrubs, Vines, and Ornamental Grasses: As specified in section 017830 “Warranties and Bonds.”

   b. Ground Covers, Biennials, Perennials, and Other Plants: As specified in section 017830 “Warranties and Bonds.”

   c. Deciduous plants in a dormant condition on the date the warranty commences will be warranted for an additional period extending through June 1 of the next following spring.

3. Include the following remedial actions as a minimum:

   a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.

   b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period. Replace plants that have bark scald; foliage of abnormal density, size, and color; or that have more than 25 percent dead or dying branches and branch tips.

   c. Provide extended warranty for period equal to original warranty period, for replaced plant material.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning within the last 2 years. Provide well-shaped, fully branched,

healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots are unacceptable.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
3. Plants shall have been grown under climatic conditions similar to those of the project site.
4. Balled and burlapped plants shall be moved as solid units having firm natural balls of soil of sufficient size to encompass the fibrous and feeding root system to ensure full and prompt plant recovery. Plants with loose, manufactured, cracked, broken, or undersized balls will be rejected.

B. Form and Structure: Unless indicated otherwise in Plant List shown on Drawings, deciduous and evergreen trees shall comply with the following:

1. Habit of growth shall be typical of the species or variety, heavy, symmetrical, well branched and proportioned, and densely foliated when in leaf.
2. Trees shall have a single, relatively straight vertical trunk and central leader. Deciduous shade trees shall be free of major branches up to a height of at least 6-feet unless otherwise specified. Evergreen and clump-form trees shall have dense, compact growth branched to the ground unless otherwise specified.
3. Trees shall be free of codominant stems and vigorous, upright branches that compete with the central leader. If the original leader has been headed, a new leader at least one-half of the diameter of the original leader shall be present.
4. Main branches shall be well-distributed along the central leader, and not clustered together. They shall form a balanced crown appropriate for the cultivar/species.
5. Branch diameter shall be no larger than two-thirds (one-half is preferred) the diameter of the central leader measured 1 inch above the branch.
6. The attachment of the largest branches (scaffold branches) shall be free of included bark.

C. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

D. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

E. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.

F. Orientation Mark: Mark field-grown deciduous trees to indicate their north orientation as grown in the nursery. Place a 1-inch diameter spot of white paint on the north side of the trunk within the bottom 12-inches of the trunk.

G. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

2.2 FERTILIZERS

A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.3 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Double-shredded softwood bark composed primarily of pine and spruce bark, un-dyed and aged not less than 9 months. Clean and free of foreign matter and disease. Sample to be approved.

2. Color: natural, un-dyed.

2.4 PESTICIDES

A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.5 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:

1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.

2.6 LANDSCAPE EDGINGS

A. Steel Edging: Standard commercial-steel edging, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.

1. Edging Size: 1/4 inch thick by 5 inches deep.

2. Stakes: Tapered steel, a minimum of 15 inches long.

3. Accessories: Standard tapered ends, corners, and splicers.

4. Finish: Hot dip galvanized steel.

B. Subject to compliance with requirements, provide above product by one of the below listed manufacturers.

1. Sure-Loc, Holland, MI (800) 787-3562, www.surelocedging.com
2. Border Concepts, Charlotte, NC (704) 541-5509, www.borderconcepts.com
3. JD Russell Company, Shelby Township, MI (800) 888-9708, www.jdrussellco.com

2.7 TREE-WATERING DEVICES

A. Slow-Release Watering Device: Standard product manufactured for drip irrigation of plants and emptying its water contents over two to three weeks; manufactured from UV-light-stabilized nylon-reinforced polyethylene sheet, PVC, or HDPE plastic.

1. Color: green.

2.8 MISCELLANEOUS PRODUCTS

A. Wood Pressure-Preservative Treatment: AWPA U1, Use Category UC4a; acceptable to authorities having jurisdiction, and containing no arsenic or chromium.

B. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

C. Burlap: Non-synthetic, biodegradable.

D. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per 0.45 kg (lb) of vesicular-arbuscular mycorrhizal fungi and 95 million spores per 0.45 kg (lb) of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

E. Free-Draining Material: Sand, gravel, stone or mixtures thereof, with not more than 70 percent by weight passing the No. 40 mesh sieve and not more than 10 percent by weight passing the No. 200 sieve.

F. Deer Repellant: Commercial product with documented deer-deterrent properties.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make adjustments as directed.

1. Plant locations on the Drawings are approximate and are to be used only as a guide. Installer shall accurately stakeout plant locations and bed outlines. Do not begin planting excavations until the Architect has approved or adjusted the stakeouts. Prior to installation, modify plant locations within the project site as directed by the Architect without additional cost to the Owner.

2. Unless otherwise indicated, massed plantings and rows of shrubs, perennials, and grasses are to be installed in a staggered triangular or diagonal configuration. Straight, square rows will not be accepted.

3.3 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil according to Section 32 91 15 "Soil Preparation (Performance Specification)."

B. Placing Planting Soil: Place prepared planting soil over exposed subgrade.

C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

D. Application of Mycorrhizal Fungi: At time directed by Architect, broadcast dry product uniformly over prepared soil at application rate according to manufacturer's written recommendations.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.

1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.

2. Excavate approximately three times as wide as ball diameter for stock.

3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.

4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.

5. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.

6. Maintain supervision of excavations during working hours.

7. Keep excavations covered or otherwise protected when unattended by Installer's personnel.

8. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.

B. Continuous Planting Beds for Shrubs:

1. Excavate shrub beds to a minimum depth of 18” with sides sloping inward at a 45-degree angle. Loosen subgrade by dragging with teeth of bucket 3” to 6” deep. Install first lift of planting soil immediately and do not allow loosened subgrade to become compacted.

2. Install planting soil in 2 equal lifts. Compact each lift to a minimum of 75% and a maximum of 82% of Standard Proctor Density. Scarify between lifts by dragging with the teeth of bucket.

3. Excavate circular planting pits in continuous beds after the planting soil has been installed in continuous beds.

C. Backfill Soil: Subsoil and topsoil removed from excavations may not be used as backfill soil unless otherwise indicated.

D. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

1. Hardpan Layer: Drill 6-inch diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

E. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

3.5 TREE, SHRUB, AND VINE PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 3 inches above adjacent finish grades. Set north mark facing north unless otherwise approved by the Architect.

1. Backfill: Planting soil Type 1 or 2.

2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.

3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 25 mm (1 inch) from root tips; do not place tablets in bottom of the hole.

   a. Quantity: According to manufacturer's written recommendations.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 3 inches above adjacent finish grades.

1. Backfill: Planting soil Type 1 or 2.

2. Carefully remove root ball from container without damaging root ball or plant.

3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 25 mm (1 inch) from root tips; do not place tablets in bottom of the hole.

   a. Quantity: According to manufacturer's written recommendations.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

6. Apply pre-emergent herbicide to spring-planted plants after soil has settled by packing and irrigation or rainfall, in accordance with the manufacturer's written instructions.

E. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 TREE, SHRUB, AND VINE PRUNING

A. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.

1. Remove dead, injured, interfering, objectionable, obstructing, and weak branches. Make clean cuts as close as possible to the trunk or parent branch without cutting into the branch collar or leaving a stub.

B. Do not apply pruning paint to wounds.

3.7 TREE STABILIZATION

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated on Drawings:

1. Upright Staking and Tying: Stake trees of 2- up 5-inch caliper. Use a minimum length required to penetrate at least 12 inches below bottom of backfilled excavation and to extend to the dimension indicated on Drawings above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.

2. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

   a. Attach flags to each guy wire, 30 inches above finish grade.

B. Trunk Stabilization by Staking and Guying: Install trunk stabilization as follows unless otherwise indicated on Drawings.

1. Proprietary Staking and Guying Device: Install staking and guying system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

3.8 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.

B. Use planting soil Type 1 or 2 for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Apply preemergent herbicide to spring-planted plants after soil has settled by packing and irrigation or rainfall, in accordance with the manufacturer’s written instructions.

H. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.9 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees and Treelike Shrubs in Turf Areas: Apply organic mulch ring of 3-inch average thickness, with 36-inch radius around trunks or stems. Do not place mulch within 6 inches of trunks or stems.

2. Organic Mulch in Planting Areas: Apply 2-inch average thickness of organic mulch extending 12 inches beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.10 EDGING INSTALLATION

A. Steel Edging: Install steel edging where indicated according to manufacturer's written instructions. Anchor with steel stakes spaced approximately 30 inches apart, driven below top elevation of edging.

3.11 INSTALLING SLOW-RELEASE WATERING DEVICE

A. Provide one device for each tree.

B. Place device on top of the mulch at base of tree stem and fill with water according to manufacturer's written instructions.

3.12 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

D. Heavily water woody plants in late fall, after leaf drop and before the ground freezes.

E. Apply pre-emergent herbicide to planted areas in early spring when the average soil temperature reaches 52 degrees F at one-half inch soil depth. If treatment is unsuccessful and weeds germinate, provide additional pre-emergent treatment after cultivating soil to remove weeds in late spring.

F. Provide early spring clean-up of perennial and ornamental grass beds before new growth starts. Cut back and remove dead top growth, repair damage, remove weeds, refresh mulch, and re-edge beds.

G. Protect plants from deer damage, including regularly monitoring deer activity and timely applications of deer repellents and barriers.

H. Upon Final Acceptance at end of Maintenance Period, remove tree-stabilization devices and planting saucers. Dress with mulch.

3.13 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.14 REPAIR AND REPLACEMENT

A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations, in a manner approved by Architect.

1. Submit details of proposed pruning and repairs.

2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.

3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size as those being replaced for each tree.

2. Species of Replacement Trees: Same species being replaced.

3.15 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

1. Do not remove Architect’s seals. The Architect will remove the seals during the Final Inspection at the end of the Maintenance Period.

E. Remove any temporary irrigation systems for plant establishment within 18 months of the start of the Maintenance Period

3.16 MAINTENANCE SERVICE

A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: Eighteen months from date of Planting Acceptance or upon Substantial Completion of the contract, whichever occurs later.

B. Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: 18 months from date of Planting Acceptance or upon Substantial Completion of the contract, whichever occurs later.

C. A sum sufficient to cover the cost of possible replacement plants will be held by the Owner until the satisfactory completion of the Maintenance Period.

END OF SECTION 32 93 00

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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 temporary transplanting of plantings for utility connection installation and re-installation of plantings after utility installation.
   1. Non-nursery-grown trees by tree spade or digging and burlapping.
   2. Non-nursery-grown shrubs and ground cover plantings.
   3. Replacement with nursery-grown plantings any transplanted materials that do not survive transplanting.
   4. Removal and replacement of landscape edgings.
      a. Edging materials shall conform to Section 32 93 00 Plants, article 2.6 Landscape Edgings.

B. Related Requirements:
   1. Section 01 56 39 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
   2. Division 1 Section 01 78 30 – “Warranties and Bonds” for warranty requirements applicable to the work of this Section.
   3. Section 32 93 00 "Plants" for new trees from nursery-grown sources.

1.3 DEFINITIONS

A. General: See definitions in ANSI A300 (Part 6) and in ANSI Z60.1 pertaining to field-grown trees, except as otherwise defined in this Section.

B. Caliper: Diameter of a trunk as measured by a diameter tape or the average of the smallest and largest diameters at a height 6 inches (150 mm) above the root flair for trees up to, and including, 4-inch (100-mm) size at this height; and as measured at a height of 12 inches (300 mm) above the root flair for trees larger than 4-inch (100-mm) size.

C. Root-Ball Depth: Measured from bottom of trunk flare to the bottom of root ball.

D. Root-Ball Width: Measured horizontally across the root ball with an approximately circular form or the least dimension for non-round root balls, not necessarily centered on the tree trunk, but within tolerance according to ANSI Z60.1.

E. Root Flare: Also called "trunk flare." The area at the base of the tree's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

1.4 REFERENCE STANDARDS

A. American Nursery and Landscape Association (ANLA). Ph: (202) 789-2900. Internet: www.anla.org.
   1. ANSI Z60.1: American Standard for Nursery Stock (2014).

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

   1. Review methods and procedures related to transplanting work include, but are not limited to, the following:

      a. Construction schedule. Verify availability of materials, personnel, equipment, and unimpeded access needed to make progress and avoid delays.
      b. Tree and plant protection.
      c. Tree maintenance.
      d. Arborist's responsibilities.

1.6 SUBMITTALS

A. Product Data: For each type of product.

B. Photographs prior to transplanting of each tree and grouping of shrubs and groundcovers that will be transplanted.

C. Photographs of “healing in” of each tree and grouping of shrubs and groundcovers that have been temporarily removed.

D. Location plan of temporarily relocated plantings, with plant protection area designation per Section 01 56 39 "Temporary Tree and Plant Protection".

E. Samples for Verification: For each of the following:
   1. Proprietary Root-Ball-Stabilization Device: One unit.
   2. Slow-Release Watering Device: One unit of each size required.

F. Pruning Schedule: Written schedule prepared by arborist detailing scope and extent of pruning each tree and schedule prepared by landscape contractor detailing scope and extent of shrub and ground cover materials in preparation for and subsequent to transplanting.

   1. Species and size of plant.
   2. Location on site plan. Include unique identifier for each.
   3. Reason for pruning of trees.
   4. Seasonal limitations on pruning of trees.
   5. Preparatory Pruning: Time schedule and description of preparatory pruning to be performed.

      a. Indicate time in months preceding the extraction of the tree.
      b. Indicate diameter of root ball and depth of root pruning for each tree.

6. Description of root and crown pruning during and subsequent to transplanting.
7. Description of maintenance following pruning.

G. Qualification Data: For qualified tree-service firm and arborist.

H. Certification: From arborist, certifying that transplanted trees have been protected during construction and that trees were promptly and properly treated and repaired when damaged.

I. Maintenance Recommendations: From arborist, recommended procedures to be established by Owner for care and protection of trees.

1. Submit before Contractor maintenance period ends.

J. Existing Conditions: Documentation of existing trees indicated to be transplanted, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1. Use sufficiently detailed color photographs or video recordings. Color shall accurately depict hue condition of foliage and bark.
2. Include drawings and notations to indicate specific wounds and damage conditions of each tree designated to be transplanted.

K. Tree-Transplanting Program: Submit before work begins.

L. Sample Warranties: For special warranties.

M. Tree-maintenance reports.

1.7 QUALITY ASSURANCE

A. Tree-Service Firm Qualifications: An experienced landscaping contractor or tree-moving firm that has successfully completed transplanting work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

1. Arborist Qualifications: Certified Arborist as certified by ISA and a Licensed arborist in jurisdiction where Project is located.

B. Tree-Transplanting Program: Prepare a written plan by arborist for transplanting trees for the whole Project, including each phase or process, tree maintenance, and protection of surrounding materials during operations. Describe in detail the materials, methods, and equipment to be used for each phase of the transplanting work.

1. Include transplanting times appropriate for each species at the Project location unless otherwise indicated on Drawings or directed by arborist.
2. Include a transplanting schedule for each species to be transplanted, coordinated with the Project schedule.
3. Include site plans clearly marked to show tree-moving routes from extraction to planting locations. Indicate proposed equipment, weight, and turning radii.
4. Show details of temporary protective barriers where needed.

5. Include diagrams showing clearances to utility lines and other encumbrances along route.
6. Include care and maintenance provisions and eventual removal of tree stabilization.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or trees.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery with appropriate certificates.

C. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees in such a manner as to destroy their natural shape.

D. Completely cover foliage when transporting trees while they are in foliage.

E. Handle trees by root ball. Do not drop trees.

F. Move trees after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after moving, set trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1.9 FIELD CONDITIONS

A. Field Measurements: Verify final grade elevations and final locations of trees and construction contiguous with trees by field measurements before proceeding with transplanting work. Perform transplanting only after finish grades are established.

B. Seasonal Restrictions: Transplant trees during the following in-season periods:

1. Spring: March 1 to May 1.
2. Fall: August 15 to October 15.

C. Weather Limitations: Proceed with transplanting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Do not transplant during excessively wet or frozen conditions. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

D. Coordination with Turf Areas (Lawns): Perform transplanting before planting turf areas unless otherwise indicated.

1. When transplanting after planting turf areas, protect turf areas, and promptly repair damage caused by transplanting operations.

E. Coordination with Planting Beds: Perform transplanting before planting bedded areas unless otherwise indicated.

1. When transplanting after planting bedded areas, protect bedding plants, and promptly repair damage caused by transplanting operations.

1.10 WARRANTY

A. Installer's Special Warranty: Tree-service firm agrees to repair or replace trees and related materials that fail within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth except for defects resulting from abuse, or incidents that are beyond Contractor's control.
b. Death and unsatisfactory growth is defined as more than 25 percent dead or in an unhealthy condition or failure to meet general performance requirements at end of warranty period.
c. Structural failures including trees falling or blowing over.
d. Faulty performance of materials and devices related to tree plantings including tree stabilization and watering devices.

2. Warranty Periods: From date of Preliminary Acceptance of planting or upon Substantial Completion of the contract, whichever occurs later.

a. Trees, Shrubs, Vines, and Ornamental Grasses: As specified in section 017830 “Warranties and Bonds.”

b. Ground Covers, Biennials, Perennials, and Other Plants: As specified in section 017830 “Warranties and Bonds.”

c. Deciduous plants in a dormant condition on the date the warranty commences will be warranted for an additional period extending through June 1 of the next following spring.

3. Include the following remedial actions as a minimum:

a. Remove dead plants and plants with unsatisfactory growth immediately.
b. Replace materials and devices related to tree plantings.
c. Provide extended warranty for period equal to original warranty period, for replaced plants.

1.11 MAINTENANCE SERVICE

A. Initial Maintenance Service: Provide plant maintenance by skilled employees and as required in Part 3. Begin maintenance immediately after preparatory pruning and continue until plantings are healthy and well established but for not less than maintenance period below.

1. Maintenance Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Transplanted plants shall be healthy and resume vigorous growth within eighteen months of transplanting without dieback due to defective extracting, handling, planting, maintenance, or other defects in the Work.

2.2 PLANTING MATERIALS

A. Backfill Soil: Planting soil of suitable moisture content and granular texture for placing and compacting in planting pit around tree, and free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.
   1. Planting Soil: Planting soil as specified in Section 32 91 15 "Soil Preparation (Performance Specification)."

2.3 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:

   1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal (38-by-38-mm actual) by length indicated, pointed at one end.
   2. Flexible Ties: Wide rubber or elastic bands or straps.
   3. Guys and Tie Wires: ASTM A641/A641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch (2.7 mm) in diameter.
   4. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.
   5. Flags: Standard surveyor's plastic flagging tape, white, 6 inches (150 mm) long.

B. Root-Ball-Stabilization Materials:

   1. Upright Stakes and Horizontal Hold-Down: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal (38-by-38-mm actual) by length indicated; stakes pointed at one end.
   2. Wood Screws: Hot-dip galvanized or stainless steel.
   3. Proprietary Root-Ball-Stabilization Devices: Proprietary at- or below-grade stabilization systems to secure each new planting by root ball; sized according to manufacturer's written instructions unless otherwise indicated.

2.4 WATERING DEVICES

A. Slow-Release Watering Device: Standard product manufactured for drip-irrigation of plants and emptying its water contents over a period of 2 to 9 hours; manufactured from UV-light stabilized nylon-reinforced polyethylene sheet, PVC, or HDPE plastic.

2.5 MISCELLANEOUS PRODUCTS

A. Organic Mulch: Double shredded bark mulch as specified in Section 32 93 00 "Plants."

B. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.

C. Burlap: Non-synthetic, biodegradable.

D. Pesticides: Pesticide registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended in writing by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

1. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
2. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

E. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
1. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross transplanting areas.

B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to transplanting work and tree protection and health.

C. Proceed with transplanting only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, other facilities, turf areas, and other plants and planting areas from damage caused by transplanting operations.

B. Utility Locator Service: Notify "Call Before You Dig" for area where Project is located before beginning excavation.

C. Locate and clearly identify trees and plant groups for transplanting. Tie a 1-inch (25-mm) blue-vinyl tape around each tree at 54 inches (1372 mm) above the ground, and around the area of shrubs, perennials and groundcovers.

D. Lay out individual transplant locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before transplanting. Make minor adjustments as required.

E. Apply antidesiccant to trees uniformly, using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during extracting, handling, and transportation.

1. If deciduous trees are moved in full leaf, spray with antidesiccant before extracting and again two weeks after transplanting.

F. Wrap trees with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during extracting, handling, and transporting.

3.3 PREPARATORY PRUNING

A. Root Pruning: Perform preparatory root pruning under direction of arborist as far in advance of extracting each tree as the Project Schedule allows.
1. Dig trench by hand or with tree spade around perimeter of tree at indicated root-ball width to the depth of the root system. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
2. Root-Ball Width: Minimum 9 inches (229 mm) of root-ball diameter, or least dimension for non-round root balls, for each inch (25 mm) of tree caliper being transplanted.
3. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking.
4. Use narrow-tine spading forks to comb soil to expose roots with minimal damage to root system.
5. Cut exposed roots manually with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
6. Do not paint or apply sealants on cut root ends.
7. Backfill trench with excavated soil.

B. Crown Pruning (Tip Pruning):
1. Perform preparatory crown pruning as directed by arborist. Follow procedures as specified in "Crown Pruning" Article.

3.4 EXCAVATION AND PLANTING EQUIPMENT

A. Tree Spade: Track-mounted mechanized tree mover; sized according to manufacturer's size recommendation for each tree being transplanted.

3.5 EXCAVATING PLANTING PITS

A. General: Excavate under supervision of the arborist.

1. Excavate planting pits or trenches with sides sloping. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil. Scarify sides of planting pit smeared or smoothed during excavation.
2. Excavate approximately three times as wide as root ball.
3. Keep excavations covered or otherwise protected until replanting trees.

B. Subsoil removed from excavations may not be used as planting soil.

C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees are encountered in excavations.

D. Seepage: Notify Architect if subsoil conditions evidence unexpected water seepage into tree-planting pits.

E. Drainage: Fill planting pit or trench with 6 inches (152 mm) of water and time the infiltration rate of the soil. If the drainage rate is less than 0.25 inch (6 mm) per hour, notify Architect to determine need for subsurface drainage.

3.6 EXTRACTING PLANTS

A. General: Extract trees under supervision of the arborist.

B. Orientation Marking: Mark the north side of each tree with non-permanent paint before extracting.

C. Root-Ball Width: Minimum 10 inches (250 mm) of root-ball diameter, or least dimension for non-round root balls, for each inch (25 mm) of tree caliper being transplanted.

1. Out-of-Season Planting: If planting before or after the in-season period for tree, provide a minimum root-ball diameter of 12 inches (305 mm) for each inch (25 mm) of tree caliper being transplanted.

D. Root-Ball Depth: As determined by the arborist for each species and size of tree and for site conditions at original and planting locations.

E. Digging:

1. Dig and clear a pit by hand or with tree spade to the depth of the root system. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
2. Use narrow-tine spading forks to comb soil to expose roots with minimal damage to root system.
3. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking.
4. Cut exposed roots manually with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not paint or apply sealants on cut root ends.
5. Temporarily support and protect exposed roots from damage until they are permanently redirected and covered with soil. Cover roots with burlap and keep them moist until planted.

F. Extracting with Tree Spade: Use the same tree spade to extract the tree as will be used to transport and plant the tree.

1. Do not use tree spade to move trees larger than the manufacturer's maximum size recommendation for the tree spade being used.
2. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.

3.7 PLANTING

A. Planting Standard: Perform planting according to ANSI A300 (Part 6) unless otherwise indicated.

B. Before planting, verify that root flare is visible at top of root ball. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

C. Ensure that root flare is visible after planting.

D. Remove injured roots by cutting cleanly; do not break. Do not paint or apply sealants on cut root ends.

E. Orientation: Position the tree so that its north side, marked before extracting, is facing north in its new location.

F. Set tree plumb and in center of planting pit with top of root flare 3 inches above adjacent finish grades.

1. Use specified backfill soil for backfill.
2. If area under the tree was initially dug too deep, add backfill to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
3. After placing some backfill around root ball to stabilize plant, begin backfilling.
4. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

5. Redirect exposed root ends downward in backfill areas where possible. Hand-expose roots as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches (75 mm) back from new construction and as required for root pruning.
6. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended by arborist. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.
7. Continue backfilling process. Water again after placing and tamping final layer of soil.

G. Planting with Tree Spade: Use the same tree spade for planting as was used to extract and transport the tree. Do not use tree spade for trees larger than the manufacturer's maximum size recommendation for the tree spade being used.

H. Slopes: When planting on slopes, set the tree so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.8 CROWN PRUNING

A. Prune branches as directed by arborist.

1. Prune to remove only injured, broken, dying, or dead branches. Do not prune for shape.
2. Do not remove or reduce living branches to compensate for root loss caused by cutting root system or to improve natural tree form.
3. Pruning Standards: Perform pruning according to ANSI A300 (Part 1).

B. Unless otherwise directed by arborist and acceptable to Architect, do not cut tree leaders.

C. Cut branches with sharp pruning instruments; do not break or chop.

D. Do not paint or apply sealants to wounds.

E. Provide subsequent maintenance during Contract period as recommended by arborist.

F. Chip removed branches and dispose of off-site.

3.9 TREE STABILIZATION

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated on Drawings or directed by arborist.

1. Upright Staking and Tying: Stake only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches (450 mm) below bottom of backfilled excavation and to extend to the dimension shown on Drawings above grade. Set stakes vertical and space to avoid penetrating root balls or root masses.
2. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

3.10 MULCHING

A. Organic Mulch: Apply 3-inch (75-mm) Insert dimension average thickness of organic mulch extending 12 inches (300 mm) beyond edge of individual planting pit and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 6 inches (150 mm) of trunks or stems.

3.11 INSTALLING SLOW-RELEASE WATERING DEVICE

A. Provide one device for each tree.

B. Place device on top of the mulch at base of tree and fill with water according to manufacturer's written instructions.

3.12 TREE MAINTENANCE

A. Perform tree maintenance as recommended by arborist. Maintain arborist observation of transplanting work.

B. Maintain trees by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Treat as required to keep trees free of insects and disease.

C. From time of preparatory root pruning or tree extraction measure soil moisture adjacent to edge of each root ball weekly. Record findings and weather conditions.

D. Fill areas of soil subsidence with backfill soil. Replenish mulch materials damaged or lost in areas of subsidence.

E. Apply treatments as required to keep tree materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

F. Pesticide Application: Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written instructions. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

1. Pre-Emergent Herbicides (Selective and Non-Selective): Apply in accordance with manufacturer's written instructions. Do not apply to seeded areas.
2. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written instructions.

G. Reports: Have arborist prepare monthly inspection reports.

3.13 REPAIR AND REPLACEMENT

A. General: Repair or replace transplanted trees and other plants indicated to remain or be relocated that are damaged by construction operations, in a manner recommended by the arborist and approved by Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.

1. Provide new trees of same size as those being replaced for each tree of 6 inches (150 mm) or smaller in caliper size.
2. Species of Replacement Trees: Same species being replaced.

3.14 CLEANUP AND PROTECTION

A. During transplanting, keep adjacent paving and construction clean and work area in an orderly condition.

B. Protect trees from damage due to transplanting operations and operations of other contractors and trades. Maintain protection during transplanting and maintenance periods. Treat, repair, or replace damaged plantings.

C. After planting and before Substantial Completion, remove tags, markings, tie tape, labels, wire, burlap, and other debris from transplanted trees, planting areas, and Project site.

3.15 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Except for materials indicated to be recycled, remove surplus soil, excess excavated material, waste materials, displaced plants, trash, and debris, and legally dispose of them off Owner's property.

B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

1. Except for materials indicated to be retained on Owner's property or recycled, remove excess excavated material, waste materials, displaced plants, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 32 96 00

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Supplementary Conditions, and Division 1 Specification sections, apply to this section.

1.2 SUMMARY

A. Provide all labor, materials, necessary equipment and services to complete the work called for in this Section or as shown on the plans, including but not necessarily limited to the following:

1. All water mains and laterals for Domestic and Fire systems.
2. Any temporary services as shown on the Drawings or as directed.
3. Rigid insulation and utility magnetic barrier tape.

B. Related Work: The following work contains requirements that may refer to this section.

1. Division 31, Section "Trenching and Backfill".
2. Division 03, Section “Cast in Place Concrete.”

1.3 REFERENCE STANDARDS

A. ANSI A21.4/AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

B. ANSI A21.10/AWWA C110 - Ductile-Iron and Gray-Iron Fittings, 3" Through 48", For Water and Other Liquids.

C. ANSI A21.11/AWWA C111 - Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings.

D. ANSI A21.50/AWWA C150 - Thickness Design of Ductile-Iron Pipe.

E. ANSI A21.51/AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water and Other Liquids.

F. ANSI A21.53/AWWA C153 - Ductile-Iron Compact Fittings, 3" Through 16", For Water and Other Liquids.

G. AWWA C500 - Gate Valves for Water and Sewage Systems.

H. AWWA C502 - Dry-Barrel Fire Hydrants.

I. AWWA C504 - Rubber-Seated Butterfly Valves.

J. AWWA C509 - Resilient-Seated Gate Valves, 3 through 12 NPS, for Water and Sewage Systems

K. AWWA C550 - Protective Interior Coatings for Valves and Hydrants

L. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

M. AWWA C651 - Disinfecting Water Mains.

N. AWWA C800 - Underground Service Line Valves and Fittings.

O. AWWA C901 - Polyethylene (PE) Pressure Pipe, Tubing, and Fittings, 1/2" through 3", for Water.

P. Groton Utilities – Water Main Services Construction Specifications

1.4 SUBMITTALS

A. Submit manufacturers' descriptive literature for all items proposed to be furnished and installed under this Section.

B. Submit manufacturers' specifications and other data required to demonstrate compliance with the specified requirements.

C. Manufacturers' recommended installation procedures which, when accepted by the Architect/Engineer, shall become the basis for inspecting and accepting or rejecting actual installation procedures used on this work.

D. Submit to the Owner and the Groton Utilities as-built drawings documenting actual location, materials, valves, fittings, sizes, and elevations, certified by a land surveyor licensed to practice in the State of Connecticut. Contractor shall submit paper prints for review. Upon acceptance of the as-built, final format shall include paper copies and electronic files in both PDF and AutoCAD 2018 formats.

1.5 TESTING

A. Testing and inspection will be performed by the Testing Agency and paid for by the Contractor.

B. The Contractor shall assist the Testing Agency as required at no additional cost to the Owner.

C. Water Department representative shall be present for all water main testing. A minimum of 24 hours notice shall be given.

PART 2 - MATERIALS

2.1 WATER SERVICE (FIRE AND DOMESTIC)

All water main work shall conform to these specifications unless more stringent requirements are indicated in the City of Groton Water Department specifications.

A. Buried water main (4" diameter or larger) shall be cement-lined, Class 52 Ductile iron double cement mortar-lined double bituminous seal coated inside, manufactured in the United States with push-on joints; size as indicated on plans. All iron pipe to be manufactured in accordance with AWWA C151, and ANSI A21.51-02 or the latest version. All pipe shall have cast on it or stamped on it means of a hand die stamp, the maker's name, or mark, the letters "DI" and the casting date. The length and weight of pipe, thickness class, and running number shall be painted on each pipe.

B. Buried water main (3" diameter or smaller) shall be copper (Type K), C-900 PVC or HDPE pipe with compression fittings.

C. Restrained joints shall be provided at all changes of direction and shall be installed in accordance with the requirements of the American Water Works Association (AWWA) and the local water company.

D. All gate valves shall be mechanical joint type. All valves shall have non-rising stems with "O" ring seals, and 2" square operating nuts and with bolts, glands, and rubber gaskets. All valves to

be built for 300 psi test pressure and 175 psi working pressure. All valves shall conform to AWWA C509-01 or the latest version. Gate valves shall open in the direction that conforms to the water company standards. All valves shall be equipped with two-piece sliding type cast iron valve box with round base and drop cover lettered "WATER." The top of the gate boxes shall be set flush with the proposed existing grade. Boxes shall be protected during backfilling operations and shall be exposed and usable before the main can be flushed and put in service.

E. Ductile-Iron Fittings: Fittings shall be ductile-iron, 350 psi pressure rating, conforming to ANSI A21.10/AWWA C110 or ANSI A21.53/AWWA C153 with mechanical joints.

F. Joints and gaskets shall conform to ANSI A21.11/AWWA C111. All joints shall either be the mechanical or push-on type, which employs a single elongated, grooved rubber gasket to effect a watertight seal. Retainer glands shall be Megalug Series 1100 manufactured by EBBE Iron Inc.

G. Coatings and Linings:

1. All pipes and fittings shall be lined with cement mortar in accordance with ANSI A21.4-80, and AWWA C104; except that the thickness of the lining shall be double that required.

2. All pipes and fittings shall be coated inside and outside with approved bituminous material, meeting requirements of ANSI A21.4-80.

3. All harnessing rods, nuts, washers, ductile iron pipes, fittings, flexible couplings, and socket clamps for harnessing, shall be coated with two layers of Inertol 49 to a total dry film thickness not less than 4 mils.

H. Butterfly Valves: Valves larger than 12" shall be butterfly valves conforming to AWWA C504 with mechanical joints and retainer glands. Butterfly valves shall have a working pressure of 175 psi. Valves shall open right.

I Indicator Valve and Post: Valve shall be as specified above, and in addition have an indicator post mounting plate. The indicator valve shall be readable at a glance in either the open or closed position, right to open. Post shall be Waterous or equal.

J. Valve Boxes: Valve boxes shall be provided for each buried valve. Boxes shall be cast-iron, of heavy pattern, adjustable type and shall be provided with cast-iron cover. The upper section of the box shall have a bottom flange of sufficient bearing area to prevent settling. The bottom of the lower section shall enclose the stuffing box and operating nut of the valve. Boxes shall have a barrel of not less than 5" diameter and cast-iron valve box extensions shall be provided when the depth of bury is greater than 5'. Boxes shall be of the sliding adjustable-type with a lap of at least 6" when in the extended position. Covers shall have the word "WATER" cast into them.

K. Hydrants:

1. Hydrants to be Centurion as manufactured by Mueller, or American Darling, Waterous, M&H or equal, but in all cases, in keeping with the Groton Utilities standards and must conform to AWWA C502. Rated working pressure 200 lbs. The hydrant must have a 5'-0" bury and have a gate on the branch. All fittings shall be mechanical joints with re-taining glands. Hydrants shall have drains and open right.

2. Hydrant specifications (Centurion by Mueller, American Darling Model B-84B, Waterous Model Pacer WB-67, or M&H Model 929 Reliant).

a. 5¼-inch main valve opening.

b. Open right hydrant valve.
c. 6-inch mechanical joint shoe with retaining gland and rubber.
d. 5'-0" minimum trench buried.
e. Traffic sectioned model.
f. National standard, 5-sided 63/64 operating nut.
g. Two 2½" nozzles, National standard fire hose threads and caps with chains.
h. One 4½" steamer, National standard fire hose threads, and cap with chain.
i. Color: Red painted bodies per college specifications on distribution mains.
j. Tee for hydrant branch shall be anchoring tee.
k. Every hydrant shall have a gate valve on the hydrant branch.

L. Corporation Stops: Corporation stops shall be compression type with pack joint. All corporation stops larger than 1" shall have saddles.

M. Curb Stops: Curb stops shall be compression non-draining type. Stops shall be furnished with 2½" diameter curb boxes having stationary rods.

N. Water Services (copper tubing): Tubing shall conform to and exceed ASTM B-88. Tubing shall be Type "K" soft copper.

O. Couplings to be used in connecting two plain ends of cast or ductile iron pipe shall be of ductile iron with eight (8) bolts and nuts complying with AWWA C111. Couplings shall be Dresser Style 38.

P. Sand Bedding: Sand for bedding and backfill shall be as specified in Section “Earthmoving.”

Q. Underground Warning Tape: Underground warning tape shall be durable, designed to withstand underground exposure, blue in color and printed with an appropriate warning message.

R. Concrete for Thrust Blocks: Concrete mix shall be 3,000 psi.

PART 3 - EXECUTION

3.1 GENERAL

A. Pipe and accessories shall be handled and stored in such a manner as to insure that pipe is insulated in sound, undamaged condition. Particular care shall be taken not to injure the pipe coatings or lining.

B. Ductile-iron pipe and fittings and cement linings are comparatively brittle. Every care shall be taken in handling and laying pipe and fittings to avoid damaging the pipe or lining, scratching or marring machined surfaces and abrasion of the pipe coating or lining.

C. Any pipe showing a distinct crack with no evidence of incipient fracture beyond the limits of the visible crack, if approved, may have the cracked portion cut off by, at the expense of the Contractor, before the pipe is laid so that the pipe used is perfectly sound. The cut shall be made in the sound barrel at a point at least 12" from the visible limits of the crack.

D. If authorized, cutting of the pipe shall be done so that the cut is square and clean, without causing damage to the pipe lining. All pipe cutting shall be done by means of an approved type of power cutter. The use of hammer and chisel, or any other method which results in rough edges, chips and damaged pipe, is prohibited.

E. Each pipe section shall be placed into position in the trench in such manner and by such means as required to cause no damage to the pipe, person or to property.

F. The Contractor shall furnish slings, straps and/or approved devices to provide satisfactory support of the pipe when it is lifted. Transportation from delivery areas to the trench shall be restricted to operations which can cause no damage to the pipe units.

G. Pipe shall not be dropped from trucks onto the ground or into the trench.

H. The Contractor shall have on the job site, with each laying crew, all the proper tools to handle and cut the pipe.

I. Damaged pipe coating and/or lining shall be restored before insulating only as approved or directed by the Engineer.

J Minimum cover on water mains and services shall be 4'-6".

K. Water mains should be at least 10 feet from any building.

M. Curb boxes should be at least 6 feet from any building.

N. Minimum size of any main line to supply a hydrant – 8 inches. Hydrant branch line size shall be a minimum of 6 inches.

3.2 CONTROL OF ALIGNMENT AND GRADE

A. The Engineer has shown benchmarks necessary for locating the work, used in the design of the work on the Drawings.

B. During construction, the Contractor shall provide the necessary stake-out of the work.

C. The Contractor shall carefully preserve benchmarks, reference points and stakes, and in case of willful or careless destruction by his own men, he will be charged with the resulting expense and shall be responsible for any mistakes or delay that may be caused by their unnecessary loss or disturbance.

3.3 PREPARATION OF BED

A. Minimum depth of bury for water lines shall be 5 feet, unless otherwise stated.

B. Water pipe must be laid on a 6-inch bedding of sand (unless in unsuitable material an additional 6" is required) and surrounded with a minimum 12-inch layer of compacted sand or other material acceptable to the Engineer.

C. As soon as excavation has been completed to require depth, place, and compact bedding material to the elevation necessary to bring the pipe to grade as specified in Section Earthmoving.

D. The compacted bed shall be rounded so that at least the bottom quadrant of the pipe shall rest firmly for the full length of the barrel. Suitable holes for bells or couplings shall be dug around the pipe joints to provide ample space for making tight joints.

3.4 LAYING PIPE

A. Laying of pipe and fittings shall be in accordance with the requirements of AWWA Specifications and as specified herein.

B. Each pipe length shall be inspected for cracks, defects in coating or lining, and any other evidence of unsuitability.

C. Pipe shall be laid in the dry and at no time shall water in the trench be permitted to flow in to the pipe.

D. The pipe shall be laid on the trench bedding, and the pipe pushed home. Jointing shall be in accordance with the manufacturer's instructions and appropriate ASTM or AWWA Standards, and the Contractor shall have on hand for each pipe laying crew, the necessary tools, gauges, pipe cutters, etc., necessary to install the pipe in a workmanlike manner. Pipe laying shall proceed upgrade with spigot ends pointing into the direction of the flow.

E. Blocking under the pipe will not be permitted except where a concrete cradle is proposed, in which case precast concrete blocks shall be used.

F. After placement of the blanket material, the pipe shall be checked for any debris, tools, etc., which shall be removed.

G. If inspection of the pipe indicates that the pipe has been properly installed as determined by the Engineer and the City of Groton Department of Utilities, the Contractor may then refill or backfill the remainder of the trench in accordance with Section Earthmoving.

H. At any time that work is not in progress, the end of the pipe shall be suitably closed to prevent the entry of animals, earth, etc.

I. Acceptable alignment shall be preserved in laying. The deflection at joints shall not exceed 3° or 1/2 of manufacturer's maximum allowable, whichever is more stringent. Fittings, in addition to those shown on the Drawings, shall be provided, if required, in crossing utilities which may be encountered upon opening the trench. Solid sleeves shall be used only where approved by the Engineer.

J. Concrete thrust blocks shall be installed at all fittings and other locations as directed by the Engineer. Minimum bearing area shall be as shown on the Drawings. Joints shall be protected by felt roofing paper prior to placing concrete.

Concrete shall be placed against undisturbed material, and shall not cover joints, bolt, or nuts, or interfere with the removal of any joint. Wooden side forms shall be provided for thrust bolts. Refer to Detail 7/C4.5. 4 for dimensions of thrust blocks.

K. Push-on joints shall be made in strict conformance with the manufacturer's instructions. Pipe shall be laid with bell ends on the upstream side. A rubber gasket shall be inserted in the groove of the bell and the end of the pipe and joint surfaces shall be cleaned and lubricated. The plain end of the pipe to be entered shall then be inserted in alignment with the bell of the pipe to which it is to be jointed and pushed home with a jack or by other means. After jointing the pipe, a metal feeler shall be used to make certain that the rubber gasket is located properly.

L. Mechanical joints at valves, fittings and where designated shall be in accordance with AWWA recommendations and the instructions of the manufacturer. To assemble the joints in the field, the Contractor shall thoroughly clean the joint surfaces and rubber gasket with soapy water before tightening the bolts. Bolts shall be tightened to the specified torques. Under no conditions shall extension wrenches or pipe over handle or ordinary ratchet wrench be used to secure greater leverage. A retainer gland instead of common follower-gland shall be used whenever mechanical joints are used.

M. Underground warning tape shall be installed in all trenches containing new water main. The minimum clearance between the pipe and the tape shall be 12 inches, with the tape installed along the centerline of the main.

3.5 INSTALLATION OF VALVES AND FITTINGS

A. Valves and boxes shall be set with the stem vertical and box vertically centered over operating nut. Valves shall be set on a firm foundation and supported by tamping selected excavation material under and at the sides of the valve. The gate box shall be supported during backfilling and maintained in vertical alignment with the top flush with finish grade.

B. Install couplings and fittings in accordance with manufacturer's instructions.

C. All valves and fittings shall be installed using mechanical joint-retainer glands.

D. Mainline valve locations shall be placed within two feet of the tees.

E. No Contractor will operate any valves or curb stops without explicit permission of the Water Department Superintendent or Inspector.

3.6 INSTALLATION OF CHLORINATION INJECTION POINTS

A. The Contractor shall be responsible for the installation of chlorination injection points, if utilized, and air release points to be utilized in testing and disinfection procedures.

B. All points installed with corporation shall be shut off at the corporation at the completion of testing and disinfection.

C. Location of injector points and blow off shall be determined in the field.

3.7 TESTING AND DISINFECTION

A. Testing and disinfection shall be as per ASTM C651-86, Sections 1 to 10 inclusive, or as specified below. The more stringent specification shall govern.

1. Flushing: Prior to disinfection and pressure testing, all water mains shall be flushed in accordance with AWWA Specification C-651 at a flow sufficient to produce a minimum velocity water supply at the time of flushing.

2. Disinfection:

   a. All pipe interiors shall be cleaned before laying and shall be kept clean thereafter. All water mains shall be disinfected in strict accordance with AWWA Specification C651. The use of chlorinated tablets will be permitted.

   b. After the main has been completed, it shall be either disinfected through a corporation stop, inserted in the pipe or by tablets. Sterilization can be accomplished by introducing a solution of clean water and chlorine having a residual chlorine strength of 50 ppm, at one end of the main and exhausting air from the other end, and at intermediate places along the main, i.e., at fire hydrants, air release valves, blow-off valves and 1-inch corporation stops installed at the extremities of the main for this purpose.

      If chlorination by tablet is utilized, the tablets shall be attached to the main by permatex #1 adhesive or equivalent. The number of 5 gram calcium hypochlorite tablets required per 20 foot length of pipe for a dose of 50 ppm shall be as follows: 4"-6", 1 tablet; 8", 2 tablets; 12", 4 tablets; and 16", 7 tablets. For 13 foot lengths or less: 4"-8", 1 tablet; 12", 3 tablets; 16", 4 tablets.

   c. During the sterilization process, the main shall be isolated from existing adjacent mains and extreme care shall be used to prevent the pressure in the main from

rising above 20 psi. This low pressure is to prevent any possibility of highly chlorinated water from entering adjacent water mains which are in service. After the main has been filled with the chlorine solution, the solution shall remain in the main for at least 24 hours to assure complete sterilization. The solution shall be tested at the extremities of the main and at intermediate points to make sure the solution has the required strength.

d. After sterilizing the main, it shall be thoroughly flushed out with potable water until the water in the main has approximately the same chlorine content as the water in the existing mains. Bacteriological samples shall be taken for testing before the main has been tested for leakage.

3. Hydrostatic Testing:

a. A pressure test and leakage test shall be performed in accordance with AWWA C600. The test pressure shall be 150 psi, the test duration shall be a two-hour minimum. Leakage shall not exceed the allowable leakage specified in AWWA C600.

b. All visible teaks are to be repaired regardless of the amount of leakage.

c. Water mains are to be tested after sterilization and flushing and shall remain isolated from adjacent mains.

d. In pipelines where bends, tees, valves, or plugs are blocked by concrete to prevent movement, pressure and leakage tests shall not be made before concrete of such blocking has taken permanent set.

e. Pressure tests shall be made in all pipelines or valves sections thereof as directed by the Engineer. The Contractor shall furnish the pump, pipe connections, taps, gauges, and all other apparatus for making the test. The line or section thereof to be tested shall be slowly filled with water and all air expelled before making the test.

f. The test pressure shall be applied by means of a pump taking water from auxiliary supply. Water mains shall be supplied by pumping clean water from sterilized container through a corporation stop installed in the ends of the main.

g. Pressure testing of each side of the intermediate valves shall be done at this time by shutting each valve and exhausting the pressure on one side and then applying the test pressure of 150 psi to the main on the opposite side of the valve. This procedure shall be repeated for each intermediate valve.

h. If the pipeline and valves do not pass the leakage test, the leak or leaks shall be located and repaired and the testing procedures repeated. The cost of the additional testing shall be the responsibility of the Contractor.

4. Bacteriological Tests:

a. Bacteriological samples shall be collected from the extremities of the main. Before a water sample is taken, the sampling tap shall be thoroughly flamed in order to kill all bacteria. Nothing should touch the lip or top of the sample bottle while the sample is being taken. The Contractor shall immediately take the samples of water to a certified lab, with the results sent to the Owner. The Owner may, at his discretion, take the samples themselves and deliver them to the laboratory.

END OF SECTION 33 11 16

ISSUED for BID

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings and general provisions of the Contract, including General Conditions, apply to this Section.

1.2 DESCRIPTION OF THE WORK

A. Sanitary sewers shall include, but are not necessarily limited to the following:

1. Piping and structures for the sanitary sewer system from a point 5 feet outside the building.
2. Connections to existing sanitary systems as shown on the plans.
3. 1,440 gallon oil/water separator.

1.3 RELATED WORK SPECIFIED ELSEWHERE

A. Section 311000: Site Utility Preparation and Demolition

B. Section 312333: Trenching and Backfilling

1.4 REGULATIONS

A. Conform to the regulations of Groton Utilities and the Connecticut Health Department and CT DEEP, each where applicable.

B. Comply with State Health Code.

1.5 SUBMITTALS

A. Shop drawings for PVC pipe and fittings, manhole frames and covers, and concrete structures.

B. Submit to the Owner and the Groton Utilities as-built drawings documenting actual location sizes, materials, and elevations, certified by a land surveyor licensed to practice in the State of Connecticut. Contractor shall submit paper prints for review. Upon acceptance of the as-built, final format shall include paper copies and electronic files in both PDF and AutoCAD 2018 formats.

1.6 REFERENCE STANDARDS

A. ASTM D 3034 - Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings (SDR-35).

B. ASTM D 2241 - PVC Sewer Pipe for force main (SDR 26)

C. ANSI/ASTM A74 - Cast Iron Soil Pipe and Fittings.

D. ANSI/ASTM D2729 - Poly Vinyl Chloride Sewer Pipe and fittings.

E. ASTM D 3033 - Type PSP Polyvinyl Chloride (PVC) Sewer Pipe and Fittings.

F. ANSI A21.11 - Rubber Gasket Joints for Cast Iron and Ductile Iron Pressure Pipe and Fittings.

G. ASTM C 32 - Sewer Manhole Brick.

H. ASTM C 91 - Masonry Cement.

I. ASTM C 478 - Precast Reinforced Concrete Manhole Section.

J. ASTM A 48 - Grey Iron Castings.

K. Groton Utilities Sanitary Sewer Construction Specifications.

L. State of Connecticut Department of Transportation Standard Specifications for Road and Bridge Construction (Form 817).

PART 2 - PRODUCTS

2.1 GENERAL

A. Concrete Structures: Article M.03 of Form 817 as amended - Class A.

B. Gravity Sewer Pipe:

1. PVC sewer pipe shall be SDR-35, push-on joint conforming to ASTM D 3034.

2. Fittings and joints shall comply with ASTM D 3139 and ASTM D 3212, respectively.

C. Underground Marking Tape:

1. All sewer main piping installed under this project shall be marked and identified by use of a 4" wide marking detection tape. The marking detection tape shall consist of a minimum 0.35 mil thickness solid aluminum foil core running the full length and width that is impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil.

2. The tape shall have imprinted the words "CAUTION BURIED SEWER LINE BELOW" continuously over its entire length in permanent black ink for identification. Material shall be a vivid opaque color (safety green for sewer) for maximum contrast with soil. Minimum weight shall be 5 pounds per 1000' unit and 3" width. Minimum tensile modulus shall be 27,000 psi and minimum tensile strength of 5,000 psi. The minimum overall thickness shall be 5.5 mils. The tape shall be as manufactured by Allen Systems, Inc. or equal.

D. Precast Concrete Manholes: Unless otherwise noted the following shall apply

1. All precast concrete riser sections shall conform to ASTM C478.

2. The barrel shall be 48-inch inside diameter with a minimum 5-inch-thick wall.

3. The cone shall have a minimum wall thickness of 5 inches at the bottom and 8 inches at the top. The cone shall taper from a 48-inch inside diameter at the bottom to a 36-inch inside diameter at the top.

4. The base shall be 60-inch or 72-inch inside diameter with a minimum 6-inch-thick wall, and a minimum 6-inch-thick floor. The top of the base shall be suitably shaped to receive barrel sections.

5. The precast concrete riser sections shall be constructed of reinforced concrete with a minimum strength of 4,000 psi at 28 days. Type II cement shall be used. Reinforcement shall be designed for HS-20 loading. Sections shall be cured as per ASTM C76 and shall not be shipped until at least 7 days after having been cast.

6. No more than two lifting holes may be cast or drilled in each section.

7. The date of manufacturer and the name or trade-mark of the manufacturer shall be clearly marked on the inside of the barrel.

E. Manhole Joints and Pipe Seals:

1. Horizontal joints between sections of the precast manholes shall depend for water tightness upon a mastic-like sealant such as Ram-Nek, Kent Seal No. 2 or equal.

2. Pipe to manhole joints shall be rubber boot type; Kor-N-Seal or equal. Water tightness shall not depend on non-shrink mortar.

F. Asphaltic Waterproofing for Manholes:

1. All manholes shall be waterproofed, at the factory, with two coats of asphaltic seal coating, applied to the exterior of the manhole in accordance with the manufacturer's recommendations. Asphaltic waterproofing shall be masonry seal MSP-1 waterproofing material as made by the Masonry Seal Corporation, 7500 West Ridge Road, Elyria, Ohio, or approved equal.

2. Exterior of all joints shall be coated with asphaltic waterproofing after setting.

G. Brick:

1. ASTM C 32, Grade SS.

H. Mortar:

1. Masonry cement: ASTM C 91.

2. Aggregate for masonry mortar: ASTM C 144.

3. Hydrated lime for masonry purposes: ASTM C 207.

4. Mortar for unit masonry: ASTM C 270, Type S.

5. Portland cement: ASTM C 150, Type II.

6. Premixed materials: ASTM C 387.

I. Castings:

1. All castings shall be grey cast iron, which meets or exceeds ASTM A48 Grade 30. Casting shall be fully machined and coal tar coated and shall be heavy-duty designed for H20 loading.

2. Sewer manhole covers and frames shall be E.J. LeBaron Type LJ-105 or equivalent. Covers shall be marked with lettering as approved by the Town of Groton Public Works Department. Manhole covers and frames shall have a 30-inch clear opening.

J. Pipe Bedding - Crushed Stone: Crushed stone shall be as specified in Section 312333.

K. Pipe Bedding - Sand Blanket: Sand shall be as specified in Section 312333.

PART 3 - EXECUTION

3.0 GENERAL

A. Pipe shall be installed in accordance with the manufacturer's recommendations and regulations. Piping shall be securely capped at the end of each day's work to prevent entrance of foreign materials.

B. Make connections to existing system in accordance with the requirements of the Department of Health, State of Connecticut, and Groton Utilities.

C. Pipes shall have a firm bearing throughout each length.

D. Where the foundation for the pipe is unsuitable, as determined by the Engineer, the unsuitable material shall be removed and replaced with gravel fill of such depth as the Engineer may direct, or special construction as ordered by the Engineer.

3.1 PIPE INSTALLATION

A. Excavation shall be to the line and grade as indicated on the Drawings and as specified herein.

B. Bedding shall be crushed stone or sand compacted to a minimum depth of 6 inches below the pipe and half the diameter above the invert of the pipe or as shown on the Drawings.

C. Pipe and accessories shall be handled and stored in a manner to ensure pipe is installed in a sound undamaged condition. Damaged pipe shall be rejected and removed from the job site.

D. The Contractor shall furnish slings, straps and/or approved devices to provide satisfactory support of the pipe when it is lifted. Transportation from delivery areas to the trench shall be restricted to operations which can cause no damage to the pipe units.

E. Pipe shall not be dropped from trucks onto the ground or into the trench.

F. The Contractor shall have on the job site, with each laying crew, all the proper tools to handle and cut the pipe.

G. During construction, the Contractor shall provide all reasonable and necessary materials and labor for laying out the sewer, setting stakes and making measurements, including the furnishing of a Connecticut licensed land surveyor. He shall not proceed until he has made timely request of the Engineer for, and has received from him, such controls, and instructions as may be necessary for the work to progress. The work shall then be done in strict conformity with such controls and instructions.

H. The Contractor shall carefully preserve benchmarks, reference points and stakes, and in case of willful or careless destruction by his own men, he will be charged with the resulting expense and shall be responsible for any mistakes or delay that may be caused by their unnecessary loss or disturbance.

I. Laying Pipe:

1. Each pipe length shall be inspected for cracks, defects and any other evidences of unsuitability.

2. Pipe shall be laid in the dry and at no time shall water in the trench be permitted to flow into the pipe.

3. The pipe shall be carefully laid to grade on trench bedding. Pipe shall be set true to line and grade using a laser beam aligner or other approved means.

4. Jointing shall be in accordance with the manufacturer's instructions and appropriate ASTM Standards, and the Contractor shall have on hand for each pipe laying crew, all tools, gauges, pipe cutters, etc., necessary to install the pipe in a workmanlike manner. Pipe laying shall proceed upgrade with spigot ends pointing in the direction of the flow.

5. Blocking under the pipe will not be permitted except where a concrete cradle is proposed, in which case precast concrete blocks shall be used.

6. After placement of the blanket material, the pipe shall be checked for line and grade and any debris, tools, etc., shall be removed.

7. If inspection of the pipe indicates that the pipe has been properly installed as determined by the Engineer, the Contractor may then refill or backfill the remainder of the trench in accordance with Section 312333.

8. At any time that work is not in progress, the end of the pipe shall be suitably closed to prevent the entry of animals, earth, etc.

9. At the end of each day's work or at intervals of length at the option of the Engineer, the Engineer, with the Contractor, will inspect the pipe for alignment with lamps or mirrors.

10. Unsatisfactory work shall be dug up and reinstalled to the satisfaction of the Engineer at no additional cost to the Owner.

3.2 PRECAST CONCRETE MANHOLES

A. Precast bases shall be placed on a layer of compacted bedding material as specified in Section 312333 and as shown on the Drawings. The excavation shall be properly dewatered while placing bedding material and setting the base.

B. Inlet and outlet stubs shall be connected and sealed in accordance with the manufacturer's recommended procedure, and as shown on the Drawings.

C. Barrel sections and cones of the appropriate combination of heights shall be placed, using manufacturer's recommended procedure for sealing the horizontal joints. Joint sealant shall be bitumastic sealant unless otherwise approved by the Engineer.

D. A leakage test shall be made as specified herein.

E. Upon successful completion of the leakage test, all joints will be pointed.

F. The exterior asphaltic waterproofing shall be touched up after installation and shall be applied to the exterior of all joints in accordance with manufacturer's recommendations.

G. The inverts and the shelf shall be constructed of brick. "Puddling" of steps in the invert shall be basis for rejection.

H. The frame and cover shall be placed on the top of the manhole or some other approved means shall be provided to prevent accidental entry by unauthorized persons, children, animals, etc., until the Contractor is ready to make final adjustment to grade.

3.3 MANHOLE FRAMES AND COVERS

A. Frames shall be set with the tops conforming accurately to the grade of the pavement or finished ground surface.

Frames shall be set concentric with the top of the masonry and in a full bed of mortar so that the space between the top of the manhole masonry and the bottom flange of the frame shall be completely filled and made watertight. A thick ring of mortar extending to the outer edge of the masonry shall be placed all around and on the top of the bottom flange. The mortar shall be smoothly finished and have a slight slope to shed water away from the frame.

B. Manhole covers shall be left in place in the frames on completion of other work at the manholes.

C. Mixing Mortar:

1. ASTM C 270.

D. Brick Masonry:

1. Only clean bricks shall be used in brickwork for grade adjustment and manhole inverts. The brick shall be moistened by suitable means, until they are in a surface dry, saturated condition.

2. Each brick shall be laid in full bed and joint of mortar without requiring subsequent grouting, flushing, or filling, and shall be thoroughly bonded.

3. Brick masonry shall be protected from too rapid drying by the use of burlap kept moist, or by other approved means, and shall be protected from the weather and frost, all as required.

4. All masonry joints which are exposed to view shall be examined to locate cracks, pointed up, and filled with mortar. Where necessary, in the opinion of the Engineer, the joints shall be cut out and repointed with setting mortar of the same color as that of the original and adjoining work.

5. All brick masonry inverts will allow unimpeded flow. Steps or puddles will be basis for rejection.

3.4 MODIFY EXISTING STRUCTURES

A. Manholes to be core drilled at the specified locations and elevations as noted on the Contract Drawings or as directed by the Owner. Jack hammering or hand work necessary for creating or enlarging the hole for the proposed pipe will not be allowed unless approved by the Owner in advance of the work.

B. Existing manhole flowline/channels to be chipped out to accommodate proposed sewer pipe and redirect flow. Surface of flowline/channel to be worked to provide smooth surface. When the condition of the manhole is such that core drilling will cause damage to the manhole, the contractor may, upon approval of the owner, alter the manhole modification construction methods to include hand methods or light jack hammering to create or enlarge the hole in the existing manhole wall, reblock or grout with non-shrink grout around the proposed pipe after installation or other construction methods as the Contractor may propose and are approved by the Owner to complete the work. This may include knocking down and rebuilding the existing manhole if approved by the Owner.

C. Contractor shall check condition and depth of existing structures which the proposed pipe is to be connected in the field prior to bidding to ensure he understands the nature and extent of the work. His work also includes modifying existing structures to meet proposed grades. This work includes the removal of top sections of structures and installing clay brick and/or precast riser sections as necessary to install the proposed top at the proper grade. Concrete brick will not be allowed.

3.5 MAINTAINING EXISTING FLOWS

A. In the course of performing this work, it may be necessary to intercept flows in the existing sanitary sewer systems, as well as their associated service laterals or other miscellaneous connections. Included in the scope of this item shall be the temporary rerouting and maintenance of these flows so as not to interfere with the proposed work and without interruption of service. The method shall be the responsibility of the contractor, but shall be approved by the Owner in advance of the starting of the work. In order to receive approval of

methods for temporary diversion or maintenance of existing sanitary sewer systems, the Contractor shall submit a written procedure, including any necessary sketches, plans, and details, to the Owner at least two (2) weeks prior to starting construction.

B. Submersible pumps shall be placed in the manhole immediately upstream from work area. Outlet hoses or temporary diversion piping are to be placed along the gutter, or in other areas that do not interrupt or interfere with traffic. When hoses cross traffic lanes, hoses to be stabilized to prevent movement caused by crossing vehicles. Outlets are to be installed in the manhole immediately downstream of work area.

C. Open structures are to be properly barricaded and protected from passing vehicles. Structures are not to be left open overnight. Outlet pipes are to be temporarily plugged at upstream end and plugs are to be removed at end of each day.

D. All sanitary sewer systems are to be restored to operating condition at the end of each working day.

PART 4 - TESTING

4.1 PIPE

A. General:

1. Leakage tests under the direction of the Engineer shall be conducted on all pipes installed under this Section of the work.

   The Engineer shall witness all tests. The Contractor shall supply all plugs, pumps, weirs, water trucks, mandrels, etc., necessary to conduct the tests.

   Should the work fail the leakage tests, corrective action shall be taken by the Contractor in a manner approved by the Engineer and, if directed by the Engineer, the Contractor shall dig up and re-lay the failed section.

2. In general, the use of sealants, applied from the inside of the pipe, will not be approved.

3. Flush all piping systems with water prior to testing.

4. Testing forms which indicate all testing information and results shall be submitted to Engineer.

END OF SECTION 33 31 00

ISSUED for BID

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Supplementary Conditions, and Division 1 Specification sections, apply to this section.

1.2 SUMMARY

A. Provide all labor, materials, necessary equipment and services to complete the work called for in this Section or as shown on the plans, including but not necessarily limited to the following:

1. Storm drainage system.
2. Cleaning of all existing and proposed storm pipes and structures within the project limits and any downstream structures as directed upon the completion of the construction activities. All collected material that is removed shall be disposed of by the Contractor off site following all state and federal guidelines.
3. Connection to existing structures.
4. Stormwater quality management.

B. Related Work: The following work contains requirements that may refer to this section.

1. Division 31, Section “Storm Water Pollution Control Plan.”
2. Division 31, Section “Trenching and Backfilling”.
3. Division 31, Section “Site Utility Preparation and Demolition”

1.3 SUBMITTALS

A. Submit manufacturers’ descriptive literature for all items proposed to be furnished and installed under this Section.

B. Submit manufacturer’s specifications and other data required to demonstrate compliance with the specified requirements.

C. Manufacturers’ recommended installation procedures which, when accepted by the Engineer, shall become the basis for inspecting and accepting (or rejecting) the actual installation procedures used on this work.

D. Submit as-built drawings to the Owner and the Town Groton. The as-built shall be certified by a land surveyor licensed to practice in the State of Connecticut. Record final and actual sizes, materials, locations, and elevations of all components on as-builts. Contractor shall submit paper prints to the Engineer for review. Upon acceptance of the as-built, final format shall include paper copies and electronic files in both PDF and AutoCAD 2018 formats.

PART 2 – MATERIALS

2.1 CATCH BASINS (CB) and YARD DRAINS (YD)

A. Catch basins shall be “C-L” or “C” State DOT standard with a sump of 4’-0” minimum below outlet, as shown on drawings unless otherwise specified.

B. Concrete yard drains shall be able to carry H-20 loading with a sump of 4'-0" minimum below outlet, as shown on drawings unless otherwise specified.

C. PVC yard drains shall include the drain basin type as indicated on the Contract Drawing. The ductile iron grates for each of these fittings are to be considered an integral part of the surface drainage inlet and shall be furnished by the same manufacturer.

1. The drain basins required for this contract shall be manufactured from PVC pipe stock, utilizing a thermo-molding process to reform the pipe stock to the specified configuration. The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system. This joint tightness shall conform to ASTM D3212 for joints for drain and sewer plastic pipe using flexible elastomeric seals. The flexible elastomeric seals shall conform to ASTM F477. The pipe bell spigot shall be joined to the main body of the drain basin or catch basin. The raw material used to manufacture the pipe stock that is used to manufacture the main body and pipe stubs of the surface drainage inlets shall conform to ASTM D1784 cell class 12454.

D. Structural steel for catch basin and concrete yard drain grates shall conform to the requirements of ASTM A-36 or A-283, Grade B or better.

E. Frames and grates shall be painted immediately before installation with a shop coat of primer and painted in the field, with a coat of RC2 Asphalt or SS-1 Emulsion.

F. Catch basins shall be constructed in accordance with the drawings. Materials used shall conform to section M.08.02 of State DOT Specification Form 817.

G. Mortar shall conform to Article M.11.04 of the DOT Specification, Form 817.

H. Catch basins and yard drains shall have frame and grates as identified on the drawings. Contractor shall provide proper risers and tops to the structures as required to accept the identified frame and grates.

I. Grates for drain basins shall be capable of supporting H-20 wheel loading in all areas. Metal used in the manufacturing of castings shall conform to ASTM A536 grade 70-50-05 for ductile iron. Yard Drain Castings shall be the following as called out on the drawings:

1. ADA Compliant:
Campbell Foundry Company pattern number 1184 or an approved equal by the engineer.

2. Non-ADA Compliant:
Neenah Foundry item number R-2556 with a standard type G grate or an approved equal by the engineer.

2.2 STORM DRAINAGE PIPING

A. Storm drainage pipe shall be PVC, RCP, or CHDPE as shown on the plans and as follows:

1. Reinforced concrete pipe & flared end sections: AASHTO-M-170. Class IV with flexible, water-tight, rubber-type gaskets conforming to AASHTO M-198.

2. Polyvinyl chloride plastic pipe to be installed in the storm drainage system shall conform to Section M.08.01-27 State of Connecticut Department of Transportation (DOT) Specification Form 817, and ASTM D-1785.

3. Polyvinyl chloride (PVC) pipe-perforated: conform to ASTM F-758 and D-1784.

4. PVC pipe shall have factory installed integral bell gasket joints and conform to ASTM F477. Connection to manholes shall be by use of manhole coupling adapters or flexible rubber connections.

5. Corrugated high density polyethylene pipe (CHDPE) to be installed in the storm drainage system shall conform to Section M.08.01-25 State of Connecticut Department of Transportation (DOT) Specification Form 817, and AASHTO M252 and M294.

2.3 MANHOLE MATERIALS

A. Precast Concrete Manhole Sections: Precast Concrete manhole sections or units shall conform to ASTM C-478 as referenced herein before. Joints for such manholes shall conform to ASTM-C443 as previously referenced.

B. Precast manhole walls shall have a minimum of 18 inches of concrete above and below any opening.

C. Monolithic base slab and wall sections shall have a minimum of 8 inches of concrete wall above the base slab.

D. All precast units shall be designed for H20 Traffic loading.

E. Manhole steps, as shown on the Drawings, shall be built into manhole walls as indicated. The top step shall be 4 inches below the manhole cover frame.

F. Manhole Castings:

1. Manholes are to be fitted with the Standard Frame and Cover, as shown on the drawings. E.J. LeBaron (Pat. No. LJ-105) cast iron frame, and 23-7/8-inch cover having one center 1-1/4-inch pick hole (Pat. No. L24C-21) or District approved equal.

2. All covers shall be appropriately marked “STORM” in a manner similar to the sewer manhole cover shown on District standard drawings, Serial No. 16902, File 62-209. “Special” frames and covers where ordered by the Engineer shall be as shown on District Standard Drawings Serial No. 16902, File 62-210.

3. Castings shall conform to ASTM Specification A-48, Class 30 and shall be thoroughly cleaned, heated, and dipped in black asphaltum paint.

G. Bank run gravel refill shall conform to the requirements of Section 312333.

H. In order to prevent covers rocking or rattling under traffic and to insure proper fit and interchangeability between different frames and covers, the lower surface of the cover and the corresponding upper surface of the frame shall be machine-finished in a lathe to provide a round, smooth, flat contact with the dimensions and clearances called for on the District's standard drawings.

I. All non-U.S. manufactured manhole frames and covers submitted for District approval and use must be clearly and conspicuously marked on the top surface of each in English letters designating the manufacturing country of origin. Such marking shall be either by means of die stamping, cast in molding, etching, or engraving. No other type of marking is acceptable.

J. Frames and covers that are to have a bolted locking device are so indicated on the Contract Drawings and shall be as shown on District standard drawing Serial No. 16902, File 62-212. Each cover shall be drilled and counter bored to a depth of ½-inch in two places 180º apart to accommodate a ½-inch diameter Type 304 stainless steel socket head cap screw. Each frame shall be drilled and tapped to accept the cap screw. The socket head cap screw shall be 1½-

inches long having 13 threads to the inch. Each frame and cover shall be marked for identification to insure that the proper cover is installed with its drilled and tapped frame.

K. Brick:

1. Brick used for inverts, water - tables and under frames and covers shall conform to ASTM C32, GRADE SM.

L. Mortar for Brickwork:

1. Mortar shall conform to Article M11.04, CONN DOT FORM 817 A -MORTAR.

M. Precast Concrete Masonry Units:

1. Precast concrete masonry units shall be machine-made solid segments, conforming to ASTM Standard Specifications for Concrete Masonry Units for Construction of Catch Basins and Manholes, Designation C139-73 (1989), with the following exceptions and additional requirements:

   a. Type II cement shall be used except as otherwise permitted.

   b. The width of the units shall be as indicated on the drawings.

   c. The inside and outside surfaces of the units shall be curved to the necessary radius and so designed that the interior surfaces of the structures shall be cylindrical, except the top batter courses shall be designed to reduce uniformly the inside section of the structure to the required size and shape at the top.

   d. Units shall be designed such that only full-length units are required to lay any one course.

   e. Acceptance of the units will be on the basis of material tests and inspection of the completed product.

   f. The Contractor shall submit 6 sets of manufacturer's information to the Engineer for approval prior to delivery of any units to the project site.

   g. The manufacturer's name and the date of manufacture shall be clearly marked on the units.

N. Mortar for Masonry Units:

1. The mortar shall be composed of one part portland cement and two parts of sand by volume with sufficient water to form a workable mixture. Cement and sand shall be as specified for mortar for brickwork.

2.4 MANHOLE FALL PREVENTION SYSTEMS

A. Where manholes exceed 20 vertical feet from the proposed rim elevation to the invert, manholes shall be provided with a fall prevention system. Fall prevention systems shall be in accordance with OSHA requirement 29 CFR 1910.27 and as described herein and as indicated on the contract drawings.

B. Carrier rail assembly shall be 1-5/16-inch O.D. by 1-inch ID Type 6061-T6 aluminum notched .875-inches by .875-inches by 5/32-inches at 6-inch centers; tapped 3/8-inches at 9-inch centers opposite notches.

C. Manhole rung clamp assembly shall be constructed from 6061-T6 aluminum 11-inches long by 1.25-inches wide with 2 slots 7/16-inches by 1.25-inches at 9-inch centers and serrated on one side.

D. Safety locking mechanism shall be cast of manganese bronze with stainless steel springs, and drop forged links and snap-locking pawl shall be minimum tensile strength of 110,000 psi. Roller bearing shall be killian type. Stainless steel springs shall comply with Military Specification QQ-W-423B.

E. Safety harness shall be adjustable to fit waists 30-inch to 48-inch. Belt shall be nylon web equipped with 3 stainless steel 'D' rings.

F. Fall preventions systems shall be manufactured by DBI/SALA, Safe Approach or approved equal.

2.5 UNDERGROUND MARKING TAPE

A. All storm piping installed under this project shall be marked and identified by use of a 4" wide marking detection tape. The marking detection tape shall consist of a minimum 0.35 mil thickness solid aluminum foil core running the full length and width that is impervious to all known alkalis, acids, chemical reagents and solvents likely to be encountered in the soil.

B. The tape shall have imprinted the words "CAUTION BURIED STORM LINE BELOW" continuously over its entire length in permanent black ink for identification. Material shall be a vivid opaque color (safety green for storm) for maximum contrast with soil. Minimum weight shall be 5 pounds per 1000' unit and 3" width. Minimum tensile modulus shall be 27,000 psi and minimum tensile strength of 5,000 psi. The minimum overall thickness shall be 5.5 mils. The tape shall be as manufactured by Allen Systems, Inc. or equal.

2.6 TRENCH DRAIN GRATES AND FRAME

A. Basis-of-Design Product: Subject to compliance with requirements, provide Standard ADA Trench Grate and Frame. Grate shall be 6” wide, light vehicular duty. Style shall match tree grates.

B. Grate Materials:

1. High quality, 100% recycled grey iron; ASTM A48 class 35b or better; hardness 170-223 brinnell.
2. Dimensions: 6” x 34” manufactured to match radius as indicated.
3. Finish: Polyester Powder Coat.
4. Color: As selected by the Landscape Architect.

C. Frame Materials:

1. Mild Steel ASTM A36.
2. Load classified for light vehicular traffic, Type “Paver Adjustable”.
3. Dimensions: to receive 6” trench drain grate manufactured to match radius as indicated.
4. All visible welds to be ground smooth.
5. Finish: Polyester Powder Coat.
6. Color: As selected by the Landscape Architect.

D. Trench Drain At Loading Dock

1. Trench drains shall be heavy duty Power Drain S100K as manufactured by ACO or approved equal.

2.7 POLYMER TRENCH DRAINS (TRACK AND FIELD ONLY)

A. Polymer trench drains shall be ACO System 4000, with neutral channel sections and Polyethylene grate and ACO System 2000, slotted drain, neutral channels, as manufactured by ACO Polymer Products, Inc., 12080 Ravenna Road, Chardon, OH 44024 or approved equal

B. Drain grates for trench drains shall be black polypropylene, UV stabilized, ADA compliant grates with 'quik loc' locking mechanism, or approved equal

C. Catch basins for trench/slot drain system shall be ACO trench drains intended for use with System 2000 and System 4000.

1. Provide matching black grate and locking mechanism for ACO System 4000 trench drains.

2. Provide polymer concrete slotted cover for ACO System 2000 slot drains.

3. Provide plastic trash bucket for all catch basins. Provide oval to round invert adapters where required.

2.8 FLAT PANEL DRAINS

A. Flat panel drains shall be Multiflow (12”) as manufactured by Varicore Technologies, Inc., P.O. Box 131, Prinsburg, MN 56281, or approved equal. All connections for proposed flat panel drains must be completed using manufacturers approved connectors. The flat panel drains must be mechanically connected to the collector pipe by the Corru-Tap (12 CTH) as manufactured by Varicore Technologies, Inc. or approved equal.

2.9 AREAWAY AND PATIO DRAIN MATERIALS

A. Frame and cover shall be 14 5/8 Square Top Prom-Deck drain, Dura-Coated cast iron body with rotatable light duty square promenade frame with seepage openings, frame clamps and decorative light duty polished bronze heel-proof grate with 3/16 wide slots. Drain shall have bottom outlet able to accommodate 6” dia. PVC outlet pipe.

B. Manufacturers:

1. Zurn Industries, LLC
2. Josam Company.
3. MIFAB, Inc.
4. Smith, Jay R. Mfg. Co.
5. Tyler Pipe; Wade Div.
6. Watts Water Technologies, Inc.

2.10 CRUSHED STONE

A. Crushed stone shall be as specified in Section 312333.

2.11 SAND BEDDING

A. Coarse sand shall be as specified in Section 312333.

2.12 FILTER FABRIC

A. Filter fabric shall be non-woven drainage fabric and shall meet the following requirements.

Grab Strength (ASTM D-4632-86) .....120 lbs.
Grab Elongation (ASTM D-4632-86) 55%
Trapezoidal Tear Strength (ASTM D-4533-85).....45 lbs.
Mullen Burst Strength (ASTM D-3786-87).....270 psi
Puncture Strength (ASTM D-3787-80) .....80 LBS

PART 3 - EXECUTION

3.1 STORM DRAINAGE SYSTEMS

A. Excavation:

1. Excavate all pits and trenches to the proper depths and elevations.
2. The bottom of all trenches shall be graded to a uniform firm bearing for the pipe throughout its entire length.
3. All required shoring shall comply with OSHA regulations.

B. Base Materials:

1. Place level and true, and compact base materials for catch basins, yard drains, and manholes.

C. Piping:

1. Control of Alignment and Grade
   a. Lay pipes to proper elevations as indicated on drawings
   b. The Contractor may use laser equipment to assist in setting the pipe provided he can demonstrate satisfactory skill in its use.
   c. The use of string levels, hand levels, carpenter's levels or other curved devices for transferring grade or setting pipe are not permitted.
   d. During construction, the Contractor shall provide the Engineer, at his request, all reasonable and necessary materials, opportunities, and assistance for setting stakes and making measurements, including the furnishing of one or two rodmen or chainmen as needed at intermittent times. He shall not proceed until he has made timely request of the Engineer for, and has received from him, such controls, and instructions as may be necessary for the work to progress. The work shall then be done in strict conformity with such controls and instructions.
   e. The Contractor shall carefully preserve benchmarks, reference points and stakes, and in case of willful or careless destruction by his own men, he will be charged with the resulting expense and shall be responsible for any mistakes or delay that may be caused by their unnecessary loss or disturbance.
2. Lay pipe by proceeding upgrade with the spigot ends of bell-and-spigot pipe. Lay the tongue ends of tongue-and-groove pipe pointing in the direction of flow.
3. Jointing Pipe

a. PVC pipe shall use Bell-and-Spigot with lock-in rubber gaskets. Ends of pipe are to be pushed home and the inner surfaces to be flush and even. PVC pipe shall have glued joints.

b. RCP shall be jointed as required by CONN DOT Form 817.

c. CPE pipe shall be jointed per the manufacturer and as required by CONN DOT Form 817.

4. Provide bedding material in accordance with the details and Section 312333.

D. Construct CB's in accordance with requirements of Article 5.07.03 of the DOT Specification, Form 817.

E. Backfill and compact all trenches and CBs, YDs and MHs as specified in Section 312333.

F. Contractor will insure that at all times, the safety ribbons or barricades are erected around the outside of all open trenches when an excavation is left open overnight. Flashing lights will be at 15 foot intervals along the barrier to insure the safe visibility of nearby individuals. The contractor will be required to return to the site after hours, should an unsafe condition be indicted by the Owner, and will immediately provide whatever safety barriers are necessary to protect the public.

G. At the completion of the project the Contractor shall clean the existing and proposed storm pipes and structures within the Contract Limit Line (CLL) as well as any sediment build-up outside the limits of construction resulting from construction activities. Pipes shall be flushed as necessary and the sumps of all basins shall be vacuumed in accordance with local procedures. All material removed from the system shall be disposed of in accordance with these specifications.

H. The specified PVC YD shall be installed using conventional flexible pipe backfill materials and procedures. The backfill material shall be crushed stone or other granular material meeting the requirements of Class 2 material as defined in ASTM D2321.

1. The drain basin body will be cut at the time of the final grade. No brick, stone or concrete block will be required to set the grate to the final grade height.

2. Bedding and backfill for surface drainage inlets shall be placed and compacted uniformly in accordance with ASTM D2321.

3. For H-20 load rated installations, a concrete ring will be poured under and around the grate and frame. The concrete slab must be designed taking into consideration local soil conditions, traffic loading, and other applicable design factors.

3.2 PRECAST CONCRETE MANHOLES

A. Precast bases shall be placed on a layer of compacted bedding material as specified in Section 312333 and as shown on the Drawings. The excavation shall be properly dewatered while placing bedding material and setting the base.

B. Inlet and outlet stubs shall be connected and sealed in accordance with the manufacturer's recommended procedure, and as shown on the Drawings.

C. Barrel sections and cones of the appropriate combination of heights shall be placed, using manufacturer's recommended procedure for sealing the horizontal joints. Joint sealant shall be bitumastic sealant unless otherwise approved by the Engineer.

D. The exterior asphaltic waterproofing shall be touched up after installation and shall be applied to the exterior of all joints in accordance with manufacturer's recommendations.

E. The inverts and the shelf shall be constructed of brick. "Puddling" of steps in the invert shall be basis for rejection.

F. The frame and cover shall be placed on the top of the manhole or some other approved means shall be provided to prevent accidental entry by unauthorized persons, children, animals, etc., until the Contractor is ready to make final adjustment to grade.

3.3 MANHOLE FRAMES AND COVERS

A. Frames shall be set with the tops conforming accurately to the grade of the pavement or finished ground surface.

Frames shall be set concentric with the top of the masonry and in a full bed of mortar so that the space between the top of the manhole masonry and the bottom flange of the frame shall be completely filled and made watertight. A thick ring of mortar extending to the outer edge of the masonry shall be placed all around and on the top of the bottom flange. The mortar shall be smoothly finished and have a slight slope to shed water away from the frame.

B. Manhole covers shall be left in place in the frames on completion of other work at the manholes.

C. Mixing Mortar:

1. ASTM C 270.

D. Brick Masonry:

1. Only clean bricks shall be used in brickwork for grade adjustment and manhole inverts. The brick shall be moistened by suitable means, until they are in a surface dry, saturated condition.

2. Each brick shall be laid in full bed and joint of mortar without requiring subsequent grouting, flushing, or filling, and shall be thoroughly bonded.

3. Brick masonry shall be protected from too rapid drying by the use of burlap kept moist, or by other approved means, and shall be protected from the weather and frost, all as required.

4. All masonry joints, which are exposed to view, shall be examined to locate cracks, pointed up, and filled with mortar. Where necessary, in the opinion of the Engineer, the joints shall be cut out and repointed with setting mortar of the same color as that of the original and adjoining work.

5. All brick masonry inverts will allow unimpeded flow. Steps or puddles will be basis for rejection.

3.4 MODIFY EXISTING STRUCTURES

A. Manholes to be core drilled at the specified locations and elevations as noted on the Contract Drawings or as directed by the Owner. Jack hammering or hand work necessary for creating or enlarging the hole for the proposed pipe will not be allowed unless approved by the Owner in advance of the work.

B. Existing manhole flowline/channels to be chipped out to accommodate proposed sewer pipe and redirect flow. Surface of flowline/channel to be worked to provide smooth surface. When the condition of the manhole is such that core drilling will cause damage to the manhole, the contractor may, upon approval of the owner, alter the manhole modification construction methods to include hand methods or light jack hammering to create or enlarge the hole in the existing manhole wall, reblock or grout with non-shrink grout around the proposed pipe after installation or other construction methods as the Contractor may propose and are approved by the Owner to complete the work. This may include knocking down and rebuilding the existing manhole if approved by the Owner.

C. The Contractor shall check condition and depth of existing structures which the proposed pipe is to be connected in the field prior to bidding to ensure he understands the nature and extent of the work.

D. Work also includes converting structures from manholes to catch basins and from catch basins to manholes. Provide frame and covers as shown on the Contract Drawings. This work includes removal/lowering of top sections of structures and installing clay brick as necessary to install the proposed top at the proper grade. Concrete brick will not be allowed.

E. This work also includes modifying existing structures to meet proposed grades. This work includes the removal of top sections of structures and installing clay brick and/or precast riser sections as necessary to install the proposed top at the proper grade. Concrete brick will not be allowed.

3.5 MAINTAINING EXISTING FLOW

A. In the course of performing this work, it may be necessary to intercept flows in existing storm drainage systems, as well as their associated service laterals or other miscellaneous connections. Included in the scope of this item shall be the temporary rerouting and maintenance of these flows so as not to interfere with the proposed work and without interruption of service. The method shall be the responsibility of the contractor, but shall be approved by the Owner in advance of the starting of the work. In order to receive approval of methods for temporary diversion or maintenance of existing storm drainage systems, the Contractor shall submit a written procedure, including any necessary sketches, plans, and details, to the Owner at least two (2) weeks prior to starting construction.

B. Submersible pumps shall be placed in the catch basin or manhole immediately upstream from work area. Outlet hoses or temporary diversion piping are to be placed along the gutter, or in other areas that do not interrupt or interfere with traffic. When hoses cross traffic lanes, hoses to be stabilized to prevent movement caused by crossing vehicles. Outlets are to be installed in the catch basin or manhole immediately downstream of work area.

C. Open structures are to be properly barricaded and protected from passing vehicles. Structures are not to be left open overnight. Outlet pipes are to be temporarily plugged at upstream end and plugs are to be removed at end of each day.

D. All storm drainage systems are to be restored to operating condition at the end of each working day.

3.6 INSTALLATION OF TRENCH DRAINS

A. Install trench drains per detail, and per manufacturer's instructions. Install drains true to line and grade, level at given elevations as shown on plan.

B. Install concrete and steel reinforcement per details, use concrete vibrators to ensure that concrete is distributed evenly underneath drain sections.

C. Replace all trench drain sections damaged by construction activities.

END OF SECTION 33 41 00