Olive Street Parking Facility
Greenfield, Massachusetts

PROJECT SPECIFICATIONS

CONSTRUCTION DOCUMENTS – BID SET
September 6, 2017

DESMAN PROJECT NO. 20-16105.01-1

Owner:	Town of Greenfield 14 Court Square Greenfield, MA 01301
Engineer of Record:	DESMAN, Inc. 18 Tremont Street, Suite 300 Boston, MA 02108
Architect of Record:	Jones Whitsett Architects 308 Main Street Greenfield, MA 01301
MEP/HVAC Consultant:	edm Engineering 166 East Street Pittsfield, MA 01201
Site/Civil Consultant:	SVE Associates 439 West River Road Brattleboro, VT 05302

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SECTION 02000
TECHNICAL SPECIFICATIONS
SITE WORK

FOR

OLIVE STREET PARKING FACILITY
GREENFIELD, MA

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CONSTRUCTION FACILITIES

Summary. Section includes:

a. Temporary utilities required by the Contractor
b. Temporary sanitary facilities
c. First aid station

Quality Assurance. Maintain temporary construction facilities in proper and safe condition throughout the progress of the Work.

Temporary Utilities. Temporary utilities services (Water, Electricity, Telephone, etc) shall be arranged by the Contractor if any of these are required by the Contractor.

Temporary Sanitary and First Aid Facilities. Provide suitably enclosed chemical or self-contained toilets for the use of the labor force employed on the Work. Toilets shall be located near the Work sites and secluded from observation insofar as possible. Toilets shall be serviced weekly, kept clean and supplied throughout the course of the Work.

Contractor shall enforce proper use of sanitary facilities.

Use of the Owner's sanitary facilities by the Contractor is prohibited.

Provide a first aid station at the site.

MOBILIZATION AND DE-MOBILIZATION

General
Erosion Control
Clearing
Grubbing
Disposal
Care of Loam
Work on Improved Property
Relocation of Trees, Shrubs, Hedges, and Fences
Work in Easements
Stone Walls and Fences
Fill
De-Mobilization
Construction Signs
Sawcutting

General. The Contractor shall furnish all labor, materials, tools and equipment necessary and shall do all work to prepare the site as indicated on the drawings and as herein specified.

Extreme care shall be taken by the Contractor and his employees not to damage trees, located outside the lime of work or that are shown to be protected on in place. The Contractor shall be responsible for all damage done.

Erosion Control. Contractor shall furnish and install all temporary erosion control measures shown on the Drawings and required by the Engineer during the life of the Contract to control soil erosion and water pollution. This includes installation and maintenance of silt fence, berms, ditches, sedimentation basins, stabilized construction exits, fiber mats, catch basin silt sacs, straw, netting, gravel, trenches, mulches, grasses, slope drains and other approved erosion control devices or methods. Erosion control shall be in place prior to any soil distributing activities including, but not limited to, clearing and grubbing, earthwork, dewatering and excavation work.

The Contractor shall inspect erosion control devise immediately after each storm event and at least daily during prolonged rainfall and maintain them in good operating condition for the life of the Contract. Fiber Rolls shall be replaced when deteriorated, and as directed by the engineer. Accumulated sediment trapped by erosion and sedimentation control devise shall be removed as required, and as directed by the Engineer.

Temporary soil erosion and sedimentation control devices shall be removed and adjacent areas outside the limits of grading restored upon completion of the work or when directed by the Engineer. Upon removal of the temporary controls, the site shall be restored to original condition.

Clearing. From areas to be cleared, the Contractor shall cut or otherwise remove all designated trees, saplings, brush, vines, and other vegetable matter such as snags, sawdust, bark, etc., and refuse.

Grubbing. The area to be grubbed shall be the same as that which is to be cleared. Grubbing shall consist of the complete removal of all tree stumps and all roots larger than 3 in. in diameter to a depth of 12 in. below the ground surface. Such depths shall be measured from the existing ground surface or the proposed finished grade, whichever is the lower.

Disposal. All material collected by the Contractor in the course of clearing and grubbing shall be hauled away for disposal off the site. Such disposal shall be carried on as promptly as possible after removal of material in the grubbing operations and shall not be left until the final period of cleaning up.

Care of Loam. Wherever work in easements is to be done, the Contractor shall first scrape all loam to one side so that it will not become mixed with the roadway or other excavation materials. After the construction work is completed, the loam shall be re-spread upon the land. No loam shall be taken away from the easements, and if the existing loam is of an insufficient amount, the Contractor at his own expense, shall furnish and spread loam to a minimum compacted thickness of 6 in.

Work on Improved Property. Trees, cultivated hedges, lawns, shrubs, and plants which might be damaged by the Contractor's operations shall be protected by suitable means or shall be dug up and temporarily replanted and cared for. After the construction operations have been substantially completed, they shall be replanted in their original positions and cared for until growth is re-established. If trees, cultivated hedges, lawns, shrubs and plants are injured to such a degree as to affect their growth or diminish their beauty or usefulness, they shall be replaced at the Contractor's expense by items of kind and quality at least equal to the kind and quality existing at the start of the Work.

In all work in improved property, the Contractor shall do such hand work as may be required to prevent damage to buildings or trees.

Relocation of Trees, Shrubs, Hedges, and Fences. Where trees, shrubs, hedges, and fences interfere with the Work, the trees, shrubs, and hedges will be replanted by the Contractor, as indicated on the plans, or directed by the Engineer. Said trees, shrubs, and hedges will be replanted on improved property. The Contractor shall be responsible for care of said plantings, and responsible for re-establishing growth. If the trees, shrubs, or hedges are injured to such a degree as to affect their growth or diminish their beauty or usefulness, they shall be replaced at the Contractor's expense.

In the instance of fences conflicting with the construction work these fences shall be relocated to private property by the Contractor as indicated on the plans, or directed by the Engineer.

Any trees, shrubs, or hedges requiring trimming over Town land shall be done by the Contractor as indicated on the plans, or as directed by the Engineer.

Work in Easements. After the construction work is completed, all easements shall be loamed and seeded as specified under LOAMING AND SEEDING.

MOBILIZATION AND DE-MOBILIZATION

Stone Walls and Fences. Wherever stone walls or fences need to be removed to provide access to the Work or if stone walls or fences are damaged during the progress of the Work, they shall be restored or repaired to as good condition as existed prior to entry, or disposed of if directed by the Engineer.

Fill. The Contractor shall fill where needed, within the easement, to provide cover as indicated on the drawings.

De-Mobilization. During its progress the work and the adjacent areas affected thereby shall be kept cleaned up and all rubbish, surplus materials, and unneeded construction equipment shall be removed and all damage repaired so that the public and property owners will be inconvenienced as little as possible.

Where material or debris have washed or flowed into or been placed in existing water courses, ditches, gutters, drains, pipes, structures, work done under this contract or elsewhere during the course of the Contractor's operations, such material or debris shall be entirely removed and satisfactorily disposed of during the progress of the work, and the ditches, channels, drains, pipes, structures, and work, etc., shall upon completion of the work, be left in a clean and neat condition.

On or before the completion of the work, the Contractor shall, unless otherwise especially directed or permitted, in writing, tear down and remove all temporary buildings and structures built by him; shall remove all temporary works, tools, and machinery or other construction equipment furnished by him; shall remove, acceptably disinfect, and cover all organic matter and material containing organic matter in, under, and around privies, houses and other buildings used by him; shall remove all rubbish from any grounds which he has occupied; and shall leave the roads and all parts of the premises and adjacent property affected by his operations in a neat and satisfactory condition.

The Contractor shall restore or replace, when and as directed, any public or private property damage by his work, equipment, or employees, to a condition at lease equal to that existing immediately prior to the beginning of operations. To this end, the Contractor shall do as required all necessary highway or driveway walk and landscaping work. Suitable materials, equipment, and methods shall be used for such restoration. The Contractor shall be responsible for replacing or resetting lost or damaged property pins and bounds, whether private or public, by a registered land surveyor.

Construction Signs. The Contractor shall supply, erect, and properly maintain all temporary advance warning construction signs in all areas to be affected by his operations. Signs shall be placed in locations shown on the plans or as specified and no work will begin until all such signs are in place and their locations approved by the Engineer.

All signs shall conform to the specifications set forth in the Manual on Uniform Traffic Control Devices, latest edition, or to specifications shown in the detail section of the plans.

Sawcutting. Any sawcutting required for the sidewalk, roadways and driveways shall be performed by the Contractor utilizing a water cooled saw, as indicated on the plans, or as directed by the Engineer.

TRAFFIC CONTROL AND UNIFORM TRAFFIC POLICE

General
Description
Traffic Requirements

General. The Contractor is responsible for furnishing and installing all traffic control devices along with the scheduling of traffic officers, and for providing all documentation.

Traffic Requirements. The Contractor is to reference the Manual of Uniform Traffic Control Devices, U.S Department of Transportation along with adhering to all applicable Greenfield Town ordinances that relate to traffic control.

The Contractor is to arrange construction activities so that all streets shall remain open to at least one-way traffic during periods of work and two-way traffic during all other time periods. Provide a traffic control plan to the Engineer for approval showing traffic signs, barrels, cones, traffic officers, including detour signs, meeting the approval of the Engineer, Owner, and local Police Departments in accordance with the Manual of Uniform Traffic Control Devices.

The Contractor shall have no claim of delay if they do not notify the Police Department of their scheduled location in time or arrange for traffic officers. The Contractor is to hand deliver written notices to individual houses affected by driveway and side road closings or detours a minimum of 24 hours in advance.

Uniformed traffic officers shall be required at locations deemed necessary by the Owner, working in conjunction with local Police and Fire Departments, for the protection of the public.

EARTH EXCAVATION, BACKFILL, FILL, AND GRADING ASSOCIATED WITH UTILITY CONSTRUCTION

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General. The Contractor shall make excavation of normal depth in earth for trenches and structures; shall backfill such excavations to the extent necessary; shall furnish the necessary materials and construct embankments and fills and shall make miscellaneous earth excavations and do miscellaneous grading. All such work shall be done as indicated on the drawings and as herein specified; including recommendations presented in the "Geotechnical Engineering Recommendations, New Parking Garage, Olive Street, Greenfield, Massachusetts" by O'Reilly, Talbot & Okun dated February 23, 2017.

The program of excavation, dewatering, sheeting, and bracing shall be carried out in such manner as to eliminate all possibility of undermining or disturbing the foundations of existing structures or of work previously completed under this contract.

Description. The Contractor shall make excavations in such manner and to such widths as will give suitable room for building the structures or laying and jointing the piping; shall furnish and place all sheeting, bracing, and supports; shall do all cofferdamming, pumping, and draining; and shall render the bottom of the excavations firm and dry and acceptable in all respects.
In no case, except as provided for in the sections TRENCH EXCAVATION and PREPARATION OF SUBGRADE, shall the earth be plowed, scraped, or dug by machinery so near to the finished subgrade as to result in the disturbance of material below said subgrade, but the last of the material to be excavated shall be removed with pick and shovel just before the placing of the pipe, masonry, or other structure.

All excavation, except as otherwise specified or permitted, shall be made in the open.

Extent of Open Excavation. The length of trench open at any one time will be controlled by the conditions, subject to any limits that may be prescribed by the Engineer.

Separation of Surface Materials. The Contractor shall remove only as much of any existing pavement as is necessary for the prosecution of the work. The pavement cut shall be made with an approved saw, without extra compensation to the Contractor. Where pavement is removed in large pieces, it shall be disposed of before proceeding with the excavation.

Sheeting and Bracing. Contractor shall observe all safety requirements and regulations set forth by the State Labor Department for the protection of the workmen, and all regulations and directives set forth under the Occupational Safety and Health Act (OSHA), as it applies to construction activities.

The Contractor shall furnish, put in place, and maintain such sheeting, bracing, etc., as may be necessary to support the sided of the excavation and to prevent any movement of earth which could in any way diminish the width of the excavation to less than that necessary for proper construction, or could otherwise injure or delay the work, or endanger adjacent structures.

Sheeting shall be driven and excavation work conducted in such a manner as to prevent material in back of sheeting from running under sheeting and into trench. Care shall be taken to prevent voids outside of sheeting and, if voids are formed, they shall be immediately filled and well rammed.

Sheeting shall not be carried to such a depth at catch basins and manholes, if it crosses the pipe that it will bear upon the pipe.

Special precautions by using sheeting, shoring and bracing shall be taken to guard against any damage to or settlement of buildings, walls, or structures that are adjacent to work.

Sheeting driven below pipe invert will be permanently left in place.

Do not brace to concrete unless express permission is given by Engineer, and only then if concrete has reached design strength as determined by compressive test of representative sample cylinders and has been cured on-site for a period of at least 14 days.

Do not embed any part or portion of sheeting or bracing in the completed work. Do not construct sleeves or openings in the structures to permit bracing through the structures unless given express permission by the Engineer.

Where sheeting is placed alongside a pipe and extends below mid-diameter, it shall be cut off at an elevation not less than 1 foot above the top of the pipe.

The sheeting, shoring, bracing, etc., or parts thereof, may be left in place after completion of work in locations where accepted in writing by Engineer. Engineer may require that, at intervals, the sheeting be left in place to support existing structures and that other sheeting be removed. All sheeting which is left in place, whether ordered by the Engineer or left for the convenience of or to serve the interests of the Contractor, shall be cut off at least 3 feet below the surface.

Drainage.

a. General. To ensure proper conditions at all time during construction, the Contractor shall provide and maintain ample means and device (including spare units kept ready for immediate use in case of breakdowns) with which to intercept and/or remove promptly and dispose properly of all water entering trenches and other excavation. Such excavations shall be kept dry until the structures, pipes, and appurtenances to be built therein have been completed to such extent that they will not be floated or otherwise damaged.

   All water pumped or drained from the work shall be disposed of in a suitable manner without undue interference with other work, damage to pavements, other surfaces, or property. Suitable temporary pipes, flumes, or channels shall be provided for water that may flow along or across the site of the work.

b. Temporary Underdrains. Temporary underdrains, if used, shall be laid in trenches beneath the grade of the structure. Trenches shall be of suitable dimensions to provide room for the chosen size of underdrain and its surrounding gravel.

   Underdrain pipe shall be acceptable vitrified clay or concrete pipe of standard thickness. Sewer pipe of the quality know as “seconds” will be acceptable.

   Underdrains, if used, shall be laid at an approved distance below the bottom of the normal excavation and with open joints wrapped in cheesecloth, and entirely surrounded by graded gravel, or crushed stone to prevent the admission of sand or other soil into the underdrains. The distance between the bottom of the pipe or structure and the top of the bell of the underdrain pipe shall be at least 3 inches unless otherwise permitted. The space between the underdrain and the pipe or structure shall be filled with screened gravel or crushed stone which shall be rammed if necessary and left with a surface suitable for laying the pipe or building the structure.

c. Drainage Wellpoint System. If necessary, the Contractor shall dewater the excavations by means of an efficient drainage wellpoint system which will drain the soil and prevent saturated soil from flowing into the excavation. The wellpoints shall be designed especially for this type of service. The pumping until shall be designed for use with the wellpoints, and shall be capable of maintaining a high vacuum and, of handling large volumes of air and water at the same time.

The installation of the wellpoints and pump shall be done under the supervision of a competent representative of the manufacturer. The Contractor shall do all special work such as surrounding the wellpoints with sand or gravel or other work which is necessary for the wellpoint system to operate for the successful dewatering of the excavations.

Trench Excavation. Where pipe is to be laid in gravel bedding or concrete cradle, the trench may be excavated by machinery to, or to just below, the designated subgrade, provided that the material remaining at the bottom of the trench is no more than slightly disturbed.

Where pipe is to be laid directly on the trench bottom, the lowest part of trenches in earth shall not be excavated to subgrade by machinery, but just before the pipe is to be placed, the last of the material to be excavated shall be removed by means of hand tools to form a flat or shaped bottom, true to grade, so that the pipe will have a uniform and continuous bearing and support on firm and undisturbed material between joint except for limited areas where the use of pipe slings may have disturbed the bottom.

Depth of Trench. Trenches shall be excavated to such depths as will permit the pipe to be laid at the elevations, slopes, or depths of cover indicated on the drawings and as specified.

Width of Trench. Pipe trenches shall be made as narrow as practicable and shall not be widened by scraping or loosening materials from the sides. Every effort shall be made to keep the sides of the trenches firm and undisturbed until backfilling has been completed and consolidated.

Trenches shall be excavated with approximately vertical sides between the elevation of the center of the pipe and an elevation one foot above the top of the pipe.

Trench Excavation in Fill. If pipe is to be laid in embankments or other recently filled material, the material shall first be placed to the top of the fill or to a height of at least one foot above the top of the pipe, whichever is the lesser. Particular care shall be taken to ensure maximum consolidation of material under the pipe location. The pipe trench shall be excavated as though in undisturbed material.

Excavation Near Existing Structures. Attention is directed to the fact that there are pipes, drains, and other utilities in certain locations. Some of these have indicated on the drawings, but no attempt has been made to show all of the services and the completeness of accuracy of the information given is not guaranteed.

As the excavation approaches pipes, conduits, or other underground structures, digging by machinery shall be discontinued and the excavation shall be done by means of hand tools. Such manual excavation when incidental to normal excavation shall be included in the work to be done under items involving normal excavation.

Where determination of the exact location of pipe or other underground structure is necessary for doing the work properly, the Contractor may be required to excavate test pits to determine such locations. When such test pits may be properly considered as incidental to other excavation, the Contractor shall receive no additional compensation, the work being understood to be included as part of the excavation. When the Engineer orders test pits beyond the limits of excavation he considers a part of the work, such test pits shall be paid for as specified under MEASUREMENT AND PAYMENT.

Protection of Existing Structures. All existing pipes, poles, wires, fences, curbing, property line markers and other structures which the Engineer decided must be preserved in place without being temporarily or permanently relocated, shall be carefully supported and protected from injury by the Contractor. Should such items be injured, they shall be restored by the Contractor, without compensation, to at least as good condition as that in which they were found immediately before the work was begun.

Relocation and Replacement of Existing Structures. Whenever the Contractor encounters certain existing structures as described below and is so ordered in writing, he shall do the whole or such portions of the work as he may be directed, to change the location of, remove and later restore, replace such structures, or to assist the owner thereof in so doing. For all such work the Contractor shall be paid under such items of work as may be applicable, other as Extra Work.

In removing existing pipes or other structures, the Contractor shall use care to avoid damage to materials, and the Engineer shall include for payment only those new materials which, in his judgment, are necessary to replace those unavoidably damaged.

The structures to which the provisions of the preceding two paragraphs shall apply include pipes, wires and other structures which meets all of the following: (a) are not indicated on the drawings otherwise provided for, (b) encroach upon or are encountered near and substantially parallel to the edge of the excavation, and (c) in the opinion of the Engineer will impede progress to such an extent that satisfactory construction cannot proceed until they have been changed in location, removed (to be later restored), or replaced.

When fences interfere with the Contractor's operations, he shall remove and (unless otherwise specified) later restore them to at least as good condition as that in which they were found immediately before the work was begun, all without additional compensation. The restoration of fences shall be done as promptly as possible and not left until the end of the construction period.

Care and Restoration of Property. The Contractor shall enclose the trunks of trees adjacent to his work and not to be cut, with substantial wooden boxes of such height as may be necessary to protect them from injury from piled material, from equipment, from his operations, or otherwise due to his work. Excavation machinery and cranes shall be of suitable type and be operated with care to prevent injury to trees not to be cut and particularly to overhanging branches and limbs.

Branches, limbs, and roots shall be cut except by permission of the Engineer. All cutting shall be smoothly and neatly done without splitting or crushing. In case of cutting or unavoidable injury to branches, limbs, and trunks or trees, the cut or injured portions shall be neatly trimmed and covered with an application of grafting wax or tree healing paint as directed.

Cultivated hedges, shrubs, and plants which might be injured by the Contractor's operations shall be protected by suitable means or shall be dug up and temporarily replanted and maintained. After the construction operations have been substantially completed, they shall be replanted in their original positions and cared for until growth is re-established. If cultivated hedges, shrubs, and plants are injured to such a degree as to affect their growth or diminish their beauty or usefulness, they shall be replaced by items of kinds and quality at least equal to the kinds and quality existing at the start of the work.

On paved surfaces the Contractor shall not use or operate tractors, bulldozers, or other power-operated equipment the treads or wheels of which are so shaped as to cut otherwise injure such surfaces.

In locations where excavation passes thus existing agricultural areas and fields, the cost of repairing the trench surface is to be included in the pipe laying price.

In such areas, the existing loam and surface materials are to be stripped and placed one side prior to excavation. After completion of backfilling, this "saved" surface material is to be returned tot he top of the trench. After natural settlement and compaction has taken place, the trench surface is to be harrowed, dragged and mechanically raked as necessary to produce a smooth and level surface. The area is then to be sowed with "orchard grass" or "rye grass" or other such materials to hold the soil and produce a growth similar to that existing prior to pipe laying operations.

This provision for clean-up in agricultural areas applies only to locations where the trench surface is now substantially pasture land or the equivalent thereof. In cases where the trench surface running alongside a road is in scrub growth or natural weed growth, this provision will not apply.

All surfaces which have been injured by the Contractor's operations shall be restored to a condition at least equal to that in which they were found immediately before work was begun. Suitable materials and methods shall be used for such restoration.

The restoration of existing property or structures shall be done as promptly as practicable and shall not be left until the end of the construction period.

Unauthorized Excavation. If the bottom of any excavation is taken out beyond the limits indicated or prescribed, the resulting void shall be backfilled at the Contractor's expense with thoroughly compacted, screened gravel, if the excavation was for a pipeline, or with Class B concrete, if the excavation was for a masonry precast structure.

Elimination of Unsuitable Material. If material unsuitable for foundation (in the opinion of the Engineer) is found at or below the grade to which excavation would normally be carried in accordance with the drawings and/or specifications, the Contractor shall remove such material to the required width and depth and replace it with thoroughly compacted screened gravel, bank-run gravel, fine aggregate or concrete as directed.

Disposal of Surplus Excavated Materials. No excavated materials shall be removed from the site of the work or disposed of by the Contractor except as directed or approved.

Surplus excavated materials suitable for backfill shall be used to backfill normal excavations in rock or to replace other materials unacceptable for use as backfill; shall be neatly deposited and graded so as to make or widen fills, flatten side slopes, or fill depressions; or shall be neatly deposited for other purposes within a haul of one mile from the point of excavation; all as directed or approved and without additional compensation.

Surplus excavated materials not needed as specified above shall be hauled away and dumped by the Contractor, at his expense, at appropriate locations, and in accordance with arrangements made by him.

Dust Control. During the progress of the work, the Contractor shall conduct his operations and maintain the area of his activities, including sweeping and sprinkling of streets as necessary, so as to minimize the creation and dispersion of dust. If the Engineer decides that it is necessary to use liquid or pelletized calcium chloride for more effective dust control, the Contractor shall furnish and spread the material as directed at no additional cost to the Owner.

Bridging Trenches. The Contractor shall, at his own expense, provide suitable and safe bridges and other crossings where requires for the accommodation of travel, and to provide access to private property during construction, and shall remove said structures thereafter.

Backfilling – General. In general, and unless other material is indicated on the drawings or specified, material used for backfilling trenches and excavations around structures shall be suitable material which was removed in the course of making the construction excavations.

Frozen material shall not be placed in the backfill nor shall backfill be placed upon frozen material. Previously frozen material shall be removed or shall be otherwise treated as required, before new backfill is placed.

Wherever a percentage of compaction for backfill is indicated or specified, it shall be the percent of maximum density at optimum moisture as determined by Method D of ASTM Standard Methods of Test for Moisture – Density Relations of Soils Using 10 lbs. Rammer and 18-inch Drop, Designation D1157-70.

Fill and Backfill Under Structures. Unless otherwise indicated or specified, all fill and backfill under structures and pavements adjacent to structures shall be compacted bank-run gravel containing not more than ten percent material passing a 200 sieve. When coarse aggregate and fine aggregate are indicated or specified for use under structures, they shall conform to the requirements for coarse and fine aggregate specified under CONCRETE MASONRY.

The fill and backfill materials shall be placed in layers not exceeding 6 inches in thickness. Unless otherwise indicated or specified, each layer shall be compacted to 95 percent.

Backfilling Around Structures. The Contractor shall not place backfill against or on structures until they have attained sufficient strength to support the loads (including construction loads) to which they will be subjected, without distortion, cracking, or other damage. As soon as practicable after the structures are structurally adequate and other necessary work has been done, special leakage tests, if required, shall be made. Promptly after the completion of such tests, the backfilling shall be started and then shall proceed until its completion.

The best of the excavated materials shall be used in backfilling within two feet of the structures. Unequal soil pressures shall be avoided by depositing the material evenly around the structures. The material shall be placed and compacted to 90 percent unless otherwise indicated or specified.

Backfilling Pipe Trenches. As soon as practicable after the pipes have been laid and the joints have acquired a suitable degree of hardness, if applicable, or the structures have been build and are structurally adequate to support the loads, including construction loads to which they will be subjected, the backfilling shall be started and thereafter it shall proceed until its completion.

With the exception mentioned below in this paragraph, trenches shall not be backfilled at pipe joints until after that section of the pipeline has successfully passed any specified test required. Should the Contractor wish to minimize the maintenance of lights and barricades and the obstruction of traffic, he may, at his own risk backfill the entire trench, omitting or including backfill at joints as soon as practicable after the joints have acquired a suitable degree of strength. He shall, however, be responsible for removing and later replacing such backfill, at his own expense, should he be ordered to do so in order to locate and repair or replace leaking or defective joints or pipe.

a. Materials. The nature of materials will govern both their acceptability for backfill and the methods best suited for their placement and compaction in the backfill. No stone or rock fragment larger than 12 inches in greatest dimension shall be placed in the backfill nor shall large masses of backfill material be dropped into the trench in such a manner as to endanger the pipeline. If necessary, a timber grillage shall be used to break the fall of material dropped from a height of more than five feet. Pieces of bituminous pavement shall be excluded from the backfill unless their use is expressly permitted, in which case they shall be broken up as directed.

b. Zone Around Pipe. The zone around the pipe shall be backfilled with the materials and to the limits indicated on the drawings. Material shall be compacted to 90 percent by tamping.

c. Remainder of Trench. The remainder of the trench above the zone around the pipe shall be compacted by tamping in accordance with the nature of the material and the compaction requirements. In general, the tamping method will be used by the Contractor to achieve the desired compaction.

d. Tamping. If the material is to be compacted by tamping, or under appropriate circumstances, rolling, the material shall be deposited and spread in uniform, parallel layers not exceeding 8 inches thick before compaction. Before the next layer is placed, each layer shall be tamped as required so as to obtain a thoroughly compacted mass. Care shall be taken that the material close to the bank, as well as in all other portions of the trench, is thoroughly compacted. When the trench width and the depth to which backfill has been placed are sufficient to make it feasible, and it can be done effectively and without damage to the pipe, backfill may, on approval, be compacted by the use of suitable rollers, tractors, or similar powered equipment instead of by tamping. For compaction by tamping (or rolling), the rate at which backfilling material is deposited in the trench shall not exceed that permitted by the facilities for its spreading, leveling and compacting as furnished by the Contractor.

   If necessary to ensure proper compaction by tamping (or rolling), the material shall first be wet by sprinkling. However, no compaction by tamping (or rolling) shall be done when the material is too wet either from rain or too great an application of water to be compacted properly; at such times the work shall be suspended until the previously placed and new materials have dried out sufficiently to permit proper compacting, or such other precautions shall be taken as may be necessary to obtain proper compaction.

g. Miscellaneous Requirements. Whatever method of compacting backfill is used, care shall be taken that stones and lumps shall not become nested and that all voids between stones shall be completely filled with fine material. Only approved quantities of stones and rock fragments shall be used in the backfill; the Contractor shall, as part of the work done under the items involving earth excavation and rock excavation as appropriate, furnish and place all other necessary backfill material.

   All voids left by removal of sheeting shall be completely backfilled with suitable materials, and thoroughly compacted.

   Excavated material which is acceptable to the Engineer for surfacing or pavement sub-base shall be placed at the top of the backfill to such depths as may be specified elsewhere or as directed. The surface shall be brought to the required grade and stones raked out and removed.

Material for Filling and Embankments. Approved selected materials available from the excavations and not required for backfill around pipes or against structures, shall be sued for filling and building embankments, except as otherwise specified. The contractor shall be responsible to handle this material, stockpile, and re-handle it as directed; all without additional compensation. Material needed in addition to that available from construction operations shall be obtained from approved gravel banks or other approved deposits.

All material, whether from the excavations or from borrow, shall be made of such nature that after it's been placed and properly compacted, it will make a dense, stable fill. It shall not contain vegetation, masses of roots, individual roots, more that 18 inches long, or more than ½ inch in diameter, stones over 6 inches in diameter, or porous matter. Organic matter shall not exceed minor quantities and shall be well distributed.

Preparation of Subgrade. The Contractor shall remove loam and topsoil, loose vegetable matter, stumps, large roots, etc., from areas upon which embankments will be built or material will be placed for grading. The subgrade shall be shaped as indicated on the drawings and shall be so prepared by forking, furrowing, or plowing that the first layer of the new material placed thereon will be well bonded to it.

Placing and Compacting Embankment Material. After the subgrade has been prepared as hereinbefore specified, the material shall be placed thereon and built up in successive layers until it has reached the required elevation.

Layers shall not exceed 12 inches in thickness before compaction. In embankments at structures, the layers shall have a slight downward slope away from the structure; in other embankments the layers shall have a slight downward slope away from the center. In general, the finer and less previous materials shall be placed against the structures or in the center, and the coarser and more pervious materials, upon the outer parts of embankments.

Each layer of material shall be compacted by the use of approved rollers or other approved means so as to secure a dense, stable, and thoroughly compacted mass. At such points as cannot be reached by mobile mechanical equipment, the materials shall be thoroughly compacted by the use of suitable power-driven tampers.

Previously placed or new materials shall be moistened by sprinkling, if required, to ensure proper bond and compaction. No compacting shall be done when the material is too wet, from either rain or too great an application of water, to compact it properly; at such times the work shall be suspended until the previously placed and new materials have dried out sufficiently to permit proper compaction, or such other precautions shall be taken as may be necessary to obtain proper compaction.

The portion of embankment constructed below proposed structures shall be compacted to 95 percent. The top two feet of an embankment below a pavement base shall be compacted to 95 percent. All other embankments shall be compacted to 90 percent.

GRAVEL BORROW

General
Gravel Borrow
Placement and Compaction

General. The gravel borrow base shall conform to the specifications set forth in the following sub-sections as well as the Commonwealth of Massachusetts Highway Department "Standard Specification for Highway and Bridges," 1988 Edition, as amended and corrected along with recommendations presented in "Geotechnical Engineering Recommendations, New Parking Garage, Olive Street, Greenfield, Massachusetts" by O'Reilly, Talbot & Okun, dated February 23, 2017.

Gravel Borrow. Gravel Borrow shall consist of inert material that is hard, durable stone and course sand, free from loam and clay, surface coatings, and deleterious materials. Gradation requirements for gravel shall be determined by AASHTO-T11 and T27 and shall conform to the following:

Sieve	Percent Passing
½ inch	50-85
No. 4	40-75
No.50	8-28
No. 200	0-10

Maximum size stone in Gravel Borrow shall be 2 inches.

All gravel borrow must be approved prior to placement. The Contractor shall deliver suitable samples of gravel borrow to the Engineer for testing purposes. At the end of a 48 hour period, the Engineer shall either accept or reject the material. Existing on-site base material must be approved by the Engineer prior to re-use.

Placement and Compaction. The base course shall be placed to the depths as specified by the Engineer or his representatives. The gravel shall be placed in a maximum of 4-inch lifts and shall be thoroughly compacted to not less than 95% of the maximum dry density.

STONE BORROW

General
Stone Borrow
Placement

General. The stone borrow base shall conform to the specifications set forth in the following sub-sections as well as the Commonwealth of Massachusetts Highway Department "Standard Specification for Highway and Bridges," 1988 Edition, as amended and corrected along with recommendations presented in "Geotechnical Engineering Recommendations, New Parking Garage, Olive Street, Greenfield, Massachusetts" by O'Reilly, Talbot & Okun, dated February 23, 2017.

Stone Borrow. Crushed stone shall consist of one or the other of the following material:

1. Durable crushed rock consisting of the angular fragments obtained by breaking and crushing solid or shattered natural rock, and free from a detrimental quantity of thin, flat, elongated or other objectionable pieces. A detrimental quantity will be considered as any amount in excess of 15% of the total weight. Thin or elongated pieces are defined as follows: Thin stones shall be considered stones whose average width exceeds four (4) times the average thickness. Elongated stones shall be considered stones whose average length exceeds four (4) times the average width

2. Durable crushed stone obtained by artificial crushing of gravel boulders for fieldstone with a minimum diameter before crushing of 8 in.

The crushed stone shall be free from clay, loam or deleterious material and not more than 1.0% of satisfactory material passing a No. 200 sieve will be allowed to adhere to the crushed stone. Where crushed stone is to be used for surfacing, this requirement shall be not more than 0.5% of satisfactory material passing a No.200 sieve. The crushed stone shall have a maximum percentage wear as determined by the Los Angeles Abrasion Test (AASHTO-T-96) as follows:

1.	For Class 1 Bit. Conc.	30%**
2.	For Cement Concrete Aggregate	45%***
3.	Crushed Stone for Subbase	45%

**Crushed stone for this use shall consist of crushed or shattered natural rock only.
***Except for 5000 psi or greater cement concrete and pre-stressed concrete which shall be 30%

The crushed stone shall be uniformly blended according to the grading requirements for the respective stone sizes shown in the following table.

Sieve	Percent Passing
1 ½” Crushed Stone	
2”	100
1 ½”	95 – 100
1”	35 – 70
¾”	0 – 25

Sieve	Percent Passing
¾ ” Crushed Stone	
1”	100
¾”	90 – 100
½”	10 – 50
3/8”	0 – 20
No. 4	0 – 5

Placement. The stone borrow shall be placed as specified by the Engineer or his representatives. The stone borrow is not intended to be an aide to dewatering.

SUBSURFACE INVESTIGATION (TEST PITS)

General. Copies of soil boring logs and groundwater monitoring data are included in the contract documents. The drawings indicate conditions as they are believed to exist upon limited subsurface exploration. Investigations and field tests should be conducted to verify conditions that exist in the field. All investigations must be conducted under the Engineer's observation.

Provide the Engineer with a 24-hour notice prior to subsurface investigation. Excavate test pit as indicated or as requested by the owner. Expose the top of the pipeline, and adjacent utilities at each test pit location. Measure the depth to the top of the pipeline, as well as to adjacent utilities, from the ground surface. Record location, depth, and size of pipelines and utilities uncovered. Record any pertinent information as a result of excavating the test pit. The Contractor may, at their expense and with permission by the Owner, perform addition explorations not ordered by the Engineer.

All subsurface investigations shall be conducted in accordance with 29 CFR Part 1926 Subpart P – OSHA Excavation Regulations 1926.650 through 1926.652 including Appendices A through F. After observation by the Engineer, backfill and compact the test pit, repair disturbed area using appropriate means.

REMOVE AND REPLACE SIDEWALK

General
Excavation to Subgrade
Forms
Adjusting Embedded Items
Placement, Finishing and Contraction Joints
Expansion Joints
Wheelchair Ramps
Linseed Anti-Spalling Compound
Joint Sealer
Curing
Welded Wire Fabric
Cure Time at Driveways
Access to Properties

General. The Contractor shall furnish all labor, materials, tools and equipment necessary to excavate and dispose of all existing sidewalks, aprons, driveway materials, and bituminous concrete as indicated on the drawings and as directed by the Engineer. The existing sidewalk shall be broken up using pneumatic hammers or other approved means, and removed and disposed of in a suitable manner. Care shall be taken to not damage or destroy any existing utilities. The Contractor shall furnish all labor, materials, tools and equipment necessary to construct a reinforced concrete sidewalk as shown on the plans and herein specified including recommendations presented in the "Geotechnical Engineering Recommendations, New Parking Garage, Olive Street, Greenfield, Massachusetts" By O'Reilly, Talbot & Okun, dated February 23, 2017.

Excavation to Subgrade. If, upon inspection of the existing gravel base course, the Engineer decided that it is a suitable base, the Contractor shall grade the existing base course to provide for surface drainage. The pitch of the sidewalk shall meet the existing grade or a grade of ¼ inch maximum per foot towards the street. If the existing base is inadequate, the Contractor shall excavate this material to the required depth and place a gravel base at a 6-inch depth under 4-inch sidewalks and 12-inch depth under 6-inch sidewalks at driveways and 9" of gravel under 6" sidewalks and handicap ramps, and pitch the sidewalk to achieve proper drainage to the street. Gravel shall be placed as specified.

Forms. Side forms and transverse forms for sidewalks shall be clean, smooth, free from warp, of sufficient strength to resist springing out of shape, and of a depth to conform to the thickness of the proposed walk. The forms shall be well staked and thoroughly braced and set to the established lines. All forms shall be oiled before placing concrete. Forms shall not be removed for 12 hours after the concrete has been placed, or long if directed.

Adjusting Embedded Items. As necessary to meet the final finished grade as indicated on the drawings, all embedded items (including but not limited to manhole covers and frames, catch basin grates and frames, valve boxes and other construction castings) shall be properly adjusted to their new elevation.

If, in the opinion of the Engineer, the existing water service valve boxes are suitable for use, the valve boxes shall be adjusted to meet proposed grade. If the existing top section cannot be adjusted to meet proposed grade a new top section shall be provided.

Placement and Finishing. The concrete sidewalk slabs shall be placed in alternate slabs 30 feet in length except as otherwise ordered. The slabs for sidewalks shall be separated by transverse preformed expansion joint fillers and sealer ½ inch thickness, as specified. Concrete placement shall comply with the requirements as specified under CONCRETE WORK for mixing and placing concrete and as herein specified. Concrete shall not be placed until forms have been checked for line and grade.

Unless otherwise specified, concrete shall be 4000 psi and shall meet MHD Standard Specifications as specified in Section M4.02.00 of the "Standard Specifications for Highways and Bridges," Commonwealth of Massachusetts, Department of Public Works, 1988 Ed., as amended and corrected. Subbase shall be moistened as necessary to provide a uniform damp condition at the time of concrete placement.

Concrete shall be placed in a continuous operation using methods which prevent segregation of mix. If placement is interrupted for more than ¼ hour, the Contractor shall place a construction joint. Construction joints shall be placed at score lines only, using a standard metal key-way section form.

After striking off and consolidating the concrete, the contractor shall smooth the surface by screening and floating. The surface shall then be checked for trueness and troweled to remove irregularities.

After troweling, contraction joints shall be scored and edging done. When excess moisture or surface sheen has disappeared, the surface shall be broomed lightly at right angles to the curb or as directed.

Tooling of edges and contraction joints shall then be repeated to remove broom finish in these areas.

The surface of all concrete sidewalks shall be uniformly scored with contraction joints into block unit of areas not more than 36 square feet as directed. The depth of the scoring shall be 1 inch.

Expansion Joints. The premolded expansion joint filler and sealer shall be as indicated on the drawings or as herein specified.

The premolded joint filler shall be:

Preformed resilient, bituminous-type filler, conforming to ASTM D994-71.

The filler strips shall be the full depth of the indicated ½-inch thick joint.

The Contractor shall provide smooth #5 bar dowels at all expansion joints and install the dowels with expansion caps as detailed at intervals of 18 to 24 inches on center.

The Contractor shall drill holes 18" minimum on center for the sliding end of dowels, in existing abutting stone or masonry to prevent surface differential movement as indicated on the plans or as directed by the Engineer.

The Contractor shall provide premolded joint filler for joints abutting curbs, manholes, hydrants, telephone poles and other fixed objects, unless otherwise indicated or directed.

Expansion joints shall be provided at approximately 30 feet on centers at the nearest even multiple of the scoring interval.

The joint filler shall extend full width and full depth of joint and shall have a cap insert or other suitable device to maintain a full joint width and an open joint of not less than ½ inch or more than 1 inch for the joint sealer. The joint sealer shall be of the polyurethane type (conforming to A.S.T.M. C920 Class 25).

Wheelchair Ramps. Wheelchair ramps shall be built at all corners and crosswalks. Wheelchair ramps shall be built to the specifications set forth in the preceding sub-sections and the concrete shall meet MHD Standard Specifications as specified in Section M4.02.00 of the "Standard Specifications for Highways and Bridges," Commonwealth of Massachusetts, Department of Public Works, 1988 Ed., as amended and corrected. Curb work shall conform to the specifications set forth, whichever applies to a given case.

Linseed Anti-Spalling Compound. The Contractor shall coat the freshly poured concrete with linseed anti-spalling compound in front of all gasoline stations. The linseed anti-spalling compound shall conform to the specifications set forth in Section M9.15.0 of the Commonwealth of Massachusetts, Department of Public Works, Standard Specifications for Highways and Bridges, 1988 Ed., as amended and corrected.

Joint Sealer. Joint sealant shall be a multi-component polyurethane type and shall comply with ASTM C920 Class 25. Joint sealants shall be installed according to the manufacturer's recommendations.

Curing. All concrete work shall be kept continuously moist for a period of 120 hours immediately following initial or completion of surface finishing. The temperature of the concrete shall be maintained between 40 degrees F and 90 degrees F during the curing period.

A membrane curing compound shall be applied after finishing work is complete. Two coats shall be applied totaling one gallon per 150 square feet, at right angles, with an approved sprayer.

Welded Wire Fabric. Welded wire fabric shall be six by six inch cold drawn steel welded mesh. All wire shall be ten (10) gauge, unless otherwise noted. Wire fabric shall be embedded in the concrete 1" from the bottom of the slab.

Cure Time at Driveways. A curing time of at least five (5) days must elapse before a sidewalk is opened to heavy truck traffic. All other vehicles may pass over the sidewalk after two (2) days have elapsed. When high early concrete is used cure time may be reduced at the Engineer's discretion.

Access to Properties. Where access to properties is critical ramps shall be placed as directed by the Engineer. Payment for ramps shall be under Item 1 Mobilization/De-Mobilization.

ADJUSTMENTS TO EXISTING STRUCTURES

General
Drainage Structures Adjusted
Sewer Manholes Adjusted
Valve Boxes and Curb Boxes Adjusted

General. The contractor shall furnish all labor, materials, and equipment and shall do all work necessary to adjust existing drainage structures, sewer manholes, valve boxes and curb boxes as indicated on the plans or as directed by the Engineer.

The work shall consist of adjusting line and/or grade of the existing frames or boxes including removal, replacement or addition of brick, mortar, and concrete.

Drainage Structures Adjusted. All work necessary for the adjustment of existing drainage structures shall conform to Item 201 of the Commonwealth of Massachusetts, Department of Public Works, Standard Specifications for Highways and Bridges, 1988 Ed., as amended and corrected.

Sewer Manholes Adjusted. All work necessary for the adjustment of existing sewer manholes shall conform to Item 202 of the Commonwealth of Massachusetts, Department of Public Works, Standard Specifications for Highways and Bridges, 1988 Ed., as amended and corrected.

Valve Boxes and Curb Boxes Adjusted. The existing valve boxes and curb boxes shall be completely removed, if necessary, and shall be reset plumb and centered directly over the operating nut.

Heavy pattern valve box and curb box extensions shall be used when the overlap of the upper section and lower section of the existing valve box or curb box is less than six (6) inches.

Concrete collars, as shown on the standard details shall be installed on all valve boxes and curb boxes located in paved areas.

FURNISHING NEW CASTINGS

Inadequate Castings: If, in the opinion of the Engineer, any of the castings to be adjusted (either frames and grates or water gate boxes) are inadequate, the Contractor shall be responsible for furnishing and delivering to the site new castings to replace them.

The Contractor shall excavate and remove the inadequate casting and replace it with the provided new casting. The inadequate castings shall be set aside for salvage by the Town.

For payment purposes, a casting removed and replaced with one provided by the Contractor, will be compensated at the same lump sum price as a casting removed and reset under the appropriate bid item.

FURNISHING AND SETTING GRANITE, PRECAST CONCRETE CURB, OR CAST IN PLACE CONCRETE CURB

General
Excavating Trench
Foundation
Setting Curb
Trench Filling
Concrete Patch
Bituminous Concrete Patch
Pointing
Mortar
Granite Curb
Precast Concrete Curb
Cast in Place Concrete Curb
Cast in Place Curb Reinforcement

General. The Contractor shall furnish all labor, materials, tools and equipment necessary to install curb as indicated on the plans and as herein specified.

Excavating Trench. The trench for the curb shall be excavated to width of 12 inches. Bituminous and cement concrete surfaces required to be removed adjacent to pavement that is to remain shall be saw-cut to 2-inch minimum depth and removed by hand pneumatic tools. The trench shall be excavated to a depth below the proposed finished grade of the curb equal to the depth of the curbstone plus 6 inches.

Foundation. The foundation for the curb shall be 6 inches deep and consist of approved gravel conforming to the specifications set forth, placed on the subgrade and thoroughly compacted.

Setting Curb. Curbing or curb corners shall be set on additional gravel placed on the foundation. All spaces under the curb or curb corners shall be filled with gravel and compacted so that the curb or curb corners will be completely supported throughout their length. The curb or curb corners shall be fitted together as close as possible. All curbs except corners shall be set with straight alignments and grades and shall, where new curb meets existing curb, match the grade and alignment.

Trench Filling. After the curb or curb corners are set, the space between the curb and the wall of the trench shall be filled with approved gravel and compacted to the proper depth.

Concrete Patch. A concrete patch 4 inches in depth shall be placed to allow for a one inch bituminous concrete patch. Concrete shall be a minimum 3000 psi mix.

Bituminous Concrete Patch. A one inch bituminous concrete patch shall be placed on the concrete and rolled to match the road surface.

Pointing. The joints between curbstones, both front and back, shall be filled with cement mortar and neatly pointed on the top and front exposed portions. After pointing, the curbstones shall be cleaned of all excess mortar that may have been forced out of the joints.

Mortar. Mortar shall conform to the specifications set forth in Section M4.02.15 of the Commonwealth of Massachusetts, Department of Public Works, Standard Specifications for Highways and Bridges, 1988 Ed., as amended and corrected.

Granite Curb. All granite curb shall conform to the specifications set forth in Section M9.04.01 of the Commonwealth of Massachusetts, Department of Public Works, Standard Specifications for Highways and Bridges, 1988 Ed., as amended and corrected, for granite curb Type VA4.

Precast Concrete Curb. All precast concrete curb shall conform to the specifications set forth in Section M4.02.14 of the Commonwealth of Massachusetts, Department of Public Works, Standard Specifications for Highways and Bridges, 1988 Ed., as amended and corrected, for precast units.

Cast in Place Concrete Curb. Cast in place concrete curb shall conform to the specifications set forth in Section 501.63 of the Commonwealth of Massachusetts, Department of Public Works, Standard Specifications for Highways and Bridges, 1988 Ed., as amended and corrected. Cast in place concrete curb shall be used whenever grades, alignments, or placement specifications cannot be met using the other types of curb.

Cast in Place Concrete Curb Reinforcement. Where concrete curbing is to be poured on an existing concrete curb base or concrete base, rodding to the existing concrete is required. The reinforcing shall be #3 bar, nine inches long placed 12 inches on center. The concrete base shall be drilled to a minimum depth of three inches. All bars shall be at least 2” below the top of the proposed curb for the full longitudinal length of the piece. This bar is to be drilled into the existing curb to each side. Drill depth is to be a minimum of 3”. This bar is to be cut and overlapped in the center, and wire tied to the other reinforcing bars. Reinforcing bars shall conform to specifications set forth in Section M8 of the Commonwealth of Massachusetts, Department of Public Works, Standard Specifications for Highways and Bridges, 1988 Ed., as amended and corrected.

CURB REMOVED AND STACKED, REMOVED AND DISPOSED

General
Removal
Stacking
Disposal

General. The Contractor shall remove the present curb, curb corners, and curb inlets of every type and cross section made of granite, bituminous concrete, or concrete, in areas shown on the plans or as directed by the Engineer, and dispose, and/or reset and/or stack them, in an area designated by the Engineer, in accordance with the specifications herein or as directed.

Removal. A trench of sufficient width and depth shall be excavated so that the present curb, curb corners, and curb inlets can be removed without damage.

Stacking. The Contractor shall be responsible for removing, handling, and stacking, in an area designated by the Engineer, all curb that is not to be reused.

Disposal. The Contractor shall be responsible for removing, handling, and disposing of all unusable curb.

BITUMINOUS CONCRETE BINDER AND SURFACE COURSES

General
Gravel
Bituminous Concrete
Clearing and Grubbing
Walk Forms
Guarantee Period

General. The Contractor shall furnish all labor, materials, tools, and equipment necessary to construct the pavement complete, including subgrade preparations, gravel base, base and surface courses on paved areas as indicated on the drawings and as herein specified including recommendations presented in the "Geotechnical Engineering Recommendations, New Parking Garage, Olive Street, Greenfield, Massachusetts" By O'Reilly, Talbot & Okun, dated February 23, 2017.

Prior to any excavation in paved areas, the Contractor shall cut the surface between the existing and proposed pavement with an approved saw. The pavement shall be cut in as straight a line as possible to assure proper bonding between the two surfaces.

Pavement shall be placed so that the whole area will have a true and uniform surface and will conform to the proper grade and cross section.

The paving plant used by the Contractor in preparation of the bituminous concrete shall be acceptable to the Engineer who shall have the right to inspect the plant and making of the material.

All manhole covers, catch basin grates, valve and meter boxes, curbs, walks, and walls shall be adequately protected and left in a clean condition.

Gravel Base. The gravel base shall conform to the specifications. The depth of gravel shall be 10" unless otherwise indicated on the plan or specified.

Bituminous Concrete. Bituminous concrete shall conform to the specifications set forth by the applicable subsections of the Commonwealth of Massachusetts, Department of Public Works, Standard Specifications for Highways and Bridges, 1988 Ed., as amended and corrected. Pavement thickness shall be equal to a 2-inch base and a 2-inch top in all areas, or as directed by the Engineer.

All longitudinal joints occurring at interface of paved lanes shall be seated utilizing a bituminous "wedge joint" at no extra cost per MA Highway Specifications Section 430.63, all intersections and driveway approaches shall be flared and matched as directed by the Engineer, Contractor to ensure proper runoff so to prevent R.O.W. runoff onto residents' property.

Clearing and Grubbing. Clearing and grubbing shall conform to the specifications.

Walk Forms. Side forms and transverse forms for sidewalks shall be clean, smooth, free from warp, of sufficient strength to resist springing out of shape and of a depth to conform to the thickness of the proposed walk. The forms shall be well staked and thoroughly braced and set to the established lines. Forms shall be removed upon completion.

Guarantee Period. For a period of one (1) year the contractor will be required to refill and or repave areas which have settled or are otherwise unsatisfactory for traffic.

BITUMINOUS CONCRETE BERM

General. The Contractor shall furnish all labor, material, and equipment to install bituminous concrete curb which is placed on a bituminous concrete base. In accordance with these specifications and in close conformity with the lines and grades shown on the plans or established by the Engineer.

The bituminous concrete mixture shall be placed and compacted with a machine acceptable and approved by the Engineer. The machine shall be capable of spreading the mixture true to line and grade and to the shape stipulated.

If at any time before the acceptance of the work any soft or imperfect spots develop in the exposed surface of the curb, such material placed shall be removed and replaced with new material and compacted. No additional compensation shall be made to the Contractor.

TEMPORARY TRENCH PATCH

General. The Contractor shall furnish all labor, material, and equipment to install and maintain temporary bituminous concrete patches associated with the Work. No permanent paving shall proceed until a minimum of 90 days has elapsed since placement of any temporary pavement. The Contractor at his own expense and with the approval of the Engineer may hire a third party testing company to insure 95% of maximum dry density at optimum moisture content as determined in accordance with ASTM D1557 has been attained in all trenches in order to waive the 90 days prior to permanent paving.

All manhole frames, catch basin frames, and utility boxes are to be set to grade of the trench patch.

Prior to work being completed at the end of the work day, place and compact a minimum of 12 inches of gravel subbase. The Contractor will be allowed to backfill the remaining trenches to grade with gravel during the work week.

All temporary pavement and structures shall be set to the existing roadway elevations with care being taken to avoid puddles.

All trenches shall be temporarily patched at the end of the work week

BITUMINOUS CONCRETE SIDEWALK AND DRIVEWAY REPAIR

General. The Contractor shall furnish all labor, material, and equipment to repair and make new bituminous concrete sidewalk and driveways. No permanent paving shall proceed until a minimum of 90 days has elapsed since placement of any temporary pavement. The Contractor at his own expense and with the approval of the Engineer may hire a third party testing company to insure 95% of maximum dry density at optimum moisture content as determined in accordance with ASTM D1557 has been attained in all trenches in order to waive the 90 days prior to permanent paving.

Driveway aprons pavements shall be removed and replaced between the edge of the road and the sidewalk or to the property line (unless otherwise marked out by the Engineer), full width, under the following conditions. If there is a trench patch in or through the driveway, if the restoration of the roadway adversely affects the pitch or drainage of the driveway, or other reasons as approved by the Engineer.

For driveway aprons approved for replacement, remove the existing pavement back to the edge of the sidewalk, property line, or other point approved by the Engineer. If there is no sidewalk, sawcut existing pavements where the new pavement will abut. The exposed subbase shall be regraded and prepared; processed gravel shall be added or removed as necessary to properly grade the subbase to accept the specified thickness of new pavement.

TACK COAT

General: The Contractor shall furnish all labor, materials and equipment and shall do all work necessary to apply Asphalt Emulsion "Tack Coat" as directed by the Engineer.

All pavement surfaces shall be tack coated immediately prior to placing each HMA lift. HMA placed over milled surfaces shall be tack coated at an application rate of 0.07 gallon per square yard. HMA placed over smooth pavements (unmilled) shall be tack coated at an application rate of 0.05 gallons per square yard.

Tack coat shall conform to the requirements of M3.11.06 of the Commonwealth of Massachusetts Department of Public Works Standard Specifications for Highways and Bridges 1988 Ed., as amended and corrected.

The existing surface shall be cleaned of all foreign matter and loose material and shall be dry before the tack coat is placed.

PRECAST CONCRETE CATCH BASINS AND MANHOLES

Summary
References
Submittals
Quality Assurance
Products/Materials
Installation
Testing

Summary. Section includes:

a. Precast concrete catch basins and manholes
b. Cast iron frames and covers

References.

AASHTO – American Association of State Highway and Transportation Officials, Standard Specifications for Highways and Bridges, most recent edition.
ASTM C32 - Standard Specification for Sewer and Manhole Brick (made from clay or shale).
ASTM A48 – Standard Specification for Gray Iron Castings.
ASTM C150 – Standard Specification for Portland Cement.
ASTM C207 – Standard Specification for Hydrated Lime for Masonry Purposes.
ASTM C478 – Standard Specification for Precast Reinforced Concrete Manhole Sections.
ASTM C443 – Standard Specification for Joints for Circular Concrete Sewer and Culvert Piping Using Rubber Gaskets.
ASTM C923 - Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes and Laterals.
ASTM C990 – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.

Submittals. Submit Shop Drawings, showing details of construction, reinforcing, joints, pipe connections to structures, manhole rungs, frames and covers, and dampproofing coating.
Submit weights of frames and covers.

Submit design calculations including verification of adequate anti-flotation features and lateral earth pressures. Calculations shall verify that the manhole or catch basin structure has been designed to withstand the burial depth, submergence due to flooding, flotation, and dead and live loads.

Quality Assurance. The quality of materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the Engineer, or other representative of the Owner. Such inspection may be made at the place of manufacture, or at the Site after delivery, or at both places, and the materials shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though samples may have been accepted as satisfactory at the place of manufacture. Material rejected after delivery to the job shall be marked for identification and shall be removed from the job at once. Materials which have been damaged after delivery will be rejected, and if already installed, shall be acceptably repaired, if permitted, or removed and replaced, at no additional cost to the Owner.

At the time of inspection, the materials will be carefully examined for compliance with the latest ASTM designation specified and these Specifications, and with the approved manufacturer's drawings. Precast concrete sections will be inspected for general appearance, dimension, "scratch-strength," blisters, cracks, roughness, and soundness. The surface shall be dense and close-textured.

Imperfections in precast concrete sections may be repaired, subject to the approval of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs will be carefully inspected before final approval. Cement mortar used for repairs shall have a minimum compressive strength of 4,000 psi at 7 days and 5,000 psi at 28 days, when tested in 3 inch by 6 inch cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the Engineer.

Personnel shall have confined space entry training as appropriate for the work to be performed. Catch basins and manholes shall be designed for lateral earth pressures and to resist flotation.

Products/Materials.
PRECAST CONCRETE SECTIONS

Precast concrete barrel sections and transition top sections, shall conform to ASTM C478 and the following requirements:

a. The wall thickness shall not be less than 5 inches for 48 inch diameter reinforced barrel sections, 6 inches for 60 inch diameter reinforced barrel sections and 7 inches for 72 inch diameter reinforced barrel sections. Wall sections shall be increased to account for extra depth conditions
b. Top sections shall be eccentric except that flat top sections shall be used where shallow cover requires a top section less than 4 feet as shown on the Drawings.
c. Barrel sections shall have tongue and groove joints.
d. All sections shall be cured by an approved method and shall not be shipped nor subjected to loading until the concrete compressive strength has attained 3,000 psi and not before 5 days after fabrication and/or repair, whichever is longer.
e. Precast concrete barrel sections with precast top slabs and precast concrete transition sections shall be designed for a minimum of AASHTO HS20-44 loading plus the weight of the soil above at 120 pcf.
f. The date of manufacture and the name and trademark of the manufacturer shall be clearly marked on each precast section.
g. Precast concrete bases shall be monolithically constructed. The thickness of the bottom slab of the precast bases shall not be less than the barrel sections or top slab whichever is greater. Precast concrete bases shall be constructed with a 6 inch extended base, unless otherwise shown on the Drawings.
h. Knock out panels for piping shall be provided in precast sections at the locations shown on the Drawings. They shall be integrally cast with the section, 2½ inches thick and shall be sized as shown on the Drawings. There shall be no steel reinforcing in knock out panels.
i. The side wall height of the base section shall be a minimum of 12 inches above the top of the pipe coming into the manholes.

BRICK MASONRY

Bricks shall be good, sound, hard and uniformly burned, regular and uniform in shape and size, of compact texture. Underburned or salmon brick will not be acceptable and only whole brick shall be used unless otherwise permitted. In case bricks are rejected by the Engineer, they shall be immediately removed from the site of the work and satisfactory bricks substituted, at no additional cost to the Owner.

a. Bricks for the channels and shelves shall comply with the latest specifications of ASTM C32 for Sewer Brick, Grade SM.

b. Bricks for building up and leveling catch basin and manhole frames shall conform to ASTM C32 Grade MS.

c. Poured concrete inverts will not be allowed.

Mortar used in the brickwork shall be composed of one part Type II Portland cement conforming to ASTM C150 to two parts sand to which a small amount of hydrated lime not to exceed 10 lbs. to each bag of cement shall be added.
Sand used shall be washed, cleaned, screened, sharp and well graded as to different sizes and with no grain larger than will pass a No. 4 sieve. Sand shall be free from vegetable matter, loam, organic or other materials of such nature or of such quantity as to render it unsatisfactory.

Hydrated lime shall conform to ASTM C207, Type S.

FRAMES AND COVERS

Frames and covers shall be of good quality, strong, tough, even grained cast iron, smooth, free from scale, lumps, blisters, sand holes and defects of any kind. Covers and frame seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer inspection. Cast iron shall conform to ASTM A48, Class 30B.

Manhole covers shall have a diamond pattern, pickholes and the word "DRAIN", cast in 3 inch letters. Catch basin and manhole frames and covers shall be manufactured by LeBaron Foundry; Mechanics Iron Foundry; Neenah Foundry or approved equal.

Frames and covers shall comply with the detail shown on the Drawings.

JOINTING PRECAST CONCRETE SECTIONS

Tongue and groove joints of precast concrete sections shall be sealed with a preformed flexible joint sealant. The preformed flexible joint sealant shall conform to ASTM C990.

MANHOLE RUNGS

Manhole rungs shall be drop front design, 14 inches wide with an abrasive step surface, steel reinforced, copolymer, polypropylene, plastic. Manhole rungs shall conform to OSHA requirements.

FLEXIBLE PIPE-TO-STRUCTURE CONNECTORS

The flexible pipe-to-structure connectors shall be designed to provide a positive seal between the connector and the structure wall and between the connector and the pipe.

The flexible boot shall be manufactured of EPDM synthetic rubber in accordance with ASTM C443 and C923 and shall be 3/8 inch thick or greater.

The external bands shall be made entirely of 304 series non-magnetic stainless steel.

The flexible connectors shall be provided with a wedge-type or toggle-type expander to secure the pipe in the structure opening.

The flexible connectors shall meet the following criteria, in accordance with ASTM C923:

a. Shall not leak when subjected to a head pressure of 10 psi for 10 minutes.
b. Shall have the ability to deflect 7 degrees in any direction without leakage under the head pressure conditions described above.
c. Shall not leak when subject to a load of 150 lbs./in. pipe diameter and the head pressure conditions described above.

DAMPPROOFING

Provide two coats of bituminous dampproofing on outer surfaces of precast manholes at the rate of 20-25 square feet per gallon in accordance with manufacturer's instructions.

Dampproofing coating shall be a factory-applied asphalt compound specially made to adhere to below grade concrete structures.

The dampproofing shall be Sonoshield semi-mastic, as manufactured by BASF; Dehydratine 4 by Euclid Chemical; RIW Marine Liquid by Toch Brothers; or approved equal.

NON-SHRINK, WATER-PROOF GROUT

Non-shrink, water-proof grout shall be Hallemite; Waterplug; Embeco; or equal.

Installation. Construct catch basins and manholes to the dimensions shown on the Drawings and as specified. Protect all work against flooding and flotation.
Set precast concrete barrel sections so as to be plumb and with sections in true alignment with a ¼ inch maximum tolerance to be allowed.

Install the precast sections in a manner that will result in a watertight joint. Seal the joints of precast concrete barrel sections with the preformed flexible joint sealant used in sufficient quantity to fill 75% of the joint cavity. Fill the outside and inside precast section joints with non-shrink grout and finish flush with the adjoining surfaces. Plug holes in the concrete barrel sections required for handling or other purposes with a non-shrink, water-proof grout or concrete and rubber plugs, and finish flush on the inside.

Backfilling shall be done in a careful manner, bringing the fill up evenly on all sides.

Pipe Connections

a. Stubs
    1. Connect pipe stubs for future extensions to the structures as shown on the Drawings and close the stub end by a suitable watertight plug.
b. For pipes with smooth exterior surfaces (PVC, ductile iron, HDPE pressure pipe, steel, etc), use flexible pipe-to-structure connectors.
c. Where flexible pipe-to-structure connectors cannot be used, such as pipes with rough, irregular or corrugated exterior surfaces (concrete, corrugated metal, HDPE drainage pipe, etc):
    1. After the new pipe has been set in place, completely fill the hole around the new pipe and structure with non-shrink, water-proof grout.
    2. Place a 6 inch thick concrete encasement a total of 12 inches in length around the pipe stub adjacent to the exterior wall of the structure. Concrete shall have a 28 day compressive strength of 3,000 psi.

Manhole Rung Installation

a. Steel reinforced copolymer polypropylene plastic steps shall be press fitted by hand driven hammer into preformed holes in cured precast sections, on 12 inch centers, by the precast concrete manufacturer.

Brickwork

a. Mix mortar only in such quantity as may be required for immediate use and use before the initial set has taken place. Do not retain mortar for more than one and one-half hours and constantly work over with a hoe or shovel until used. Anti-freeze mixtures will not be allowed in the mortar. No masonry shall be laid when the outside temperature is below 40°F unless provisions are made to protect the mortar, bricks, and finished work from frost by heating and enclosing the work with tarpaulins or other suitable material. The Engineer's decision as to the adequacy of protection against freezing shall be final.
b. Construct channels and shelves of brick as shown on the Drawings. The brick channels shall correspond in shape with the lower half of the pipe. The top of the shelf shall be set at the elevation of the crown of the highest pipe and shall be sloped 1 inch per foot to drain toward the flow through channel. Construct brick surfaces exposed to sewage flow with the nominal 2 inch by 8 inch face exposed (i.e., bricks on edge).
c. Set catch basin and manhole covers and frames in a full mortar bed and bricks, a maximum of 12 inches thick for conical tops and 6 inches thick for flat top sections, utilized to assure frame and cover are set to the existing grade. Reset the frames and covers to final grade prior to placement of final paving.

CLEANING

Clean new catch basins and manholes of silt, debris and foreign matter of any kind, prior to final inspection.

Testing. All precast manholes shall be subject to testing. The testing shall be one of two ways.
Vacuum Testing:

- Plug all openings with non-shrink grout and plug all pipes with suitable plugs.
- An initial vacuum of ten (10) inches Hg. Shall be drawn
- Test times shall be determined by the time required for the vacuum to drop from ten (10) inches Hg. to nine (9) inches Hg.
  - -Allowance test times are listed below:

Manhole Depth	Minimum Test Time
0 to 10 feet	1 minute
10 to 15 feet	1 ¼ minutes
15 to 25 feet	1 ½ minutes

Manholes which fail to meet the above minimum test times shall be repaired using methods approved by the Engineer.

After the manhole has been repaired it shall be re-tested using the same vacuum test procedure. Following a second vacuum test failure, the manhole shall be repaired and tested using the water exfiltration method.

Exfiltration Test.

- All pipes and openings shall be suitably plugged and braced to prevent blowouts.
- Fill manhole to the top, seal all visible leaks.
- Allow a period of time for absorption by the concrete and refill as required.
- The test period shall be eight (8) hours.
- At the end of the test period, the manhole shall be refilled to the top measuring the volume of water added. This amount shall be extrapolated to a 24 hour rate and the leakage determined on the basis of depth.
  - -The leakage for each manhole shall not exceed one (1) gallon per vertical foot for a 24 hour period
  - -If the manhole fails this requirement, and the leakage does not exceed three (3) gallons per vertical foot per day, repairs by approved methods may be made to bring the leakage within the allowable rate of one (1) gallon per foot per day
  - -Leakage due to a defective section or joint or exceeding the three (3) gallons per vertical foot per day, shall be the cause for the rejection of the manhole.
  - -It shall be the Contractors responsibility to uncover the manhole as necessary and to disassemble, reconstruct, replace it.

If the groundwater table is above the highest joint in the manhole, and if there is no leakage into the manhole, such a test can be used to evaluate the water-tightness of the manhole.

REHABILITATE EXISTING STRUCTURES

General: The Contractor shall furnish all labor, materials and equipment and shall do all work necessary to rehabilitate existing sewer or drain structures as directed by the Engineer.

The work shall consist of removing castings and deteriorated masonry until a clean sound base is obtained upon which concrete blocks and clay bricks may be used to rebuild the structure.

The remodeling shall conform to the Commonwealth of Massachusetts Department of Public Works Standard Specifications for Highways and Bridges 1988 Ed., as amended and corrected, applicable parts of Section 201.

24”, 18”, 15”, 12”, 8”, & 6” HDPE, PVC, RCP STORM DRAIN AND SEWER PIPE

General
Installation
Inspection/Testing

General. The contractor shall furnish all labor, materials, and equipment and shall do all work necessary to install dual wall, smooth interior, corrugated polypropylene pipe meeting or exceeding AASHTO MP 21-11 or corrugated polyethylene pipe meeting or exceeding AASHTO M294. All pipe joints shall be gasketed bell and spigot. Gaskets shall be integral to the spigot and protected from debris during installation. A gasket lubricant shall be applied to the bell and gasket during assembly.

The contractor shall furnish all labor, materials, and equipment and shall do all work necessary to install Poly Vinyl Chloride (PVC) or Chlorinated Poly Vinyl Chloride (CPVC) Plastic Pipe, Schedule 35, and Reinforced Concrete Pipe (RCP). All PVC pipe shall meet ASTM D 1785 Standard Specification. Fittings, such as adapters, couplings, etc. shall be the same materials as the pipe. Joints shall be made in accordance with ASTM D 2855 Recommended Practice for Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Pipe Fittings. Cements shall meet ASTM D 2564. All RCP pipe shall meet ASTM C 76-16 Standard Specification for RCP or ASTM C 655-15 standards for RCP D-Load .

All storm drain system pipes shall consist of RCP pipe that conforms to the requirements of AASHOT-M170 for Standard Strength Reinforced Concrete Culvert Pipe for Class III Pipe, unless otherwise designated on the plans, except that the steel area for 24 in. pipe shall be 0.10 square inch per foot and circular reinforcement only shall be used in circular pipes. All pipe 24 in. in diameter or smaller shall be of the bell-and spigot type. Pipes larger than 24 in. in diameter shall be tongue and groove or bell and spigot.

Installation. The Contractor shall be responsible for and pay all costs for the layout of the drain and sewer system. The Contractor shall be responsible for verifying in the field all lines, grades, dimensions and conditions affecting the work, and for all correct connections of all parts of the piping and structures in the completed drain.

The Contractor shall be responsible to verify existing invert elevations at the locations where new work shall connect to existing systems. Notify the Engineer in writing of any discrepancies found prior to starting work.

Each pipe shall be inspected prior to installation. Any pipe unit deemed defective, either before or after installation shall be removed and replaced at no additional cost to the Owner.

All pipe and fittings shall be clear of all debris, dirt, etc., prior to installation and shall be kept clean until work is accepted. Pipe and fittings shall be installed accurately to the lines and grades indicated on the drawings or as required by the Engineer. Pipes shall be laid in the dry and with the spigot end pointing in the direction of flow. At all times when pipe installation is not in progress, the open ends of the pipe shall be closed with temporary water tight plugs, or by other suitable means.

In order to insure minimum amount of movement or disturbance, no more than two (2) lengths of pipe may be laid before backfilling to a minimum of twelve (12) inches over the pipe.

The Contractor shall make all connections to the existing facilities as required by the Contract Documents.

- Provide all pipe, fittings, and appurtenances.
- Shall do all excavation and backfill as required.
- The pipe entrance to existing manholes shall be core drilled to the required diameter.
- Special attention shall be made to protect the existing sewers and structures.

Inspection/Testing.. At intervals along the sewer work, usually not more than 1000 feet, at the option of the Engineer, all portions of all sewers shall be subject to leakage tests witnessed by the Engineer. The Contractor shall have on hand all plugs, pumps, weirs, water trucks, compressors, etc., necessary to conduct the tests.

- Low Pressure Air Test: Leakage testing by means of low pressure air shall be in accordance with the procedures described in UNI-B-6, “Recommended Practices for Low Pressure Air Testing of Installed Sewer Pipe”, published by the Uni-Bell Plastic Pipe Association.

The leakage test shall be made on each manhole-to-manhole section of pipeline.

ABANDON EXISTING STRUCTURES

General. The Contractor shall furnish all labor, materials, tools and equipment necessary and shall do all work to abandon existing manholes, as specified below, as indicated on the drawings and as directed by the Engineer. Care will be taken not to damage other subsurface utilities.

Seal pipes that are to be abandoned with a concrete plug not less than 1 ½ times the pipe diameter long in the barrel of the pipeline. For example, a 10-inch diameter pipe will require that a minimum 15-inch long plug be installed. This should be performed at the manhole unless the existing manhole is to be removed. Concrete shall have a 28-day compressive strength of 3000 psi and a maximum stone size of 1 ½ inches.

Structures shall be abandoned to 3 feet below grade. The removed frames and covers shall be stored on the site for salvage by the Owner.

The Contractor shall backfill the remaining portion of the structure with clean sand and compact the sand to 90 percent density.

The excavation shall be backfilled with an approved material in accordance with EARTH EXCAVATION, BACKFILL, FILL AND GRADING.

LOAM AND SEED

Summary
References
Quality Assurance
Submittals
Products/Materials
Preparation
Lawn Areas
Maintenance
Guarantee Period and Final Acceptance

Summary. Section includes:

a. Restoration of all vegetated areas disturbed during construction including lawn areas
b. Loam, starter fertilizer, lime, and lawn seed
c. Mulch

References.
ASTM D5539 – Standard Specification for Seed Starter Mix.

Quality Assurance. Place seed only between the periods from April 15th to June 1st, and from August 15th to October 1st, unless otherwise approved by the Engineer.

Submittals. Submit the following for approval:
Lawn seed mixture including percent by weight of each seed type, and manufacturer/supplier name.
Suitable laboratory analysis of the soil to determine the quantity of fertilizer and lime to be applied.
Lime and starter fertilizer application rates based on laboratory soil tests.

Products/Materials.

Loam

Loam shall consist of fertile, friable, natural topsoil typical of the locality without admixture of subsoil, refuse or other foreign materials and shall be obtained from a well-drained arable site. It shall be such a mixture of sand, silt and clay particles as to exhibit sandy and clayey properties in and about equal proportions. It shall be reasonably free of stumps, roots, heavy or stiff clay, stones larger than 1-inch in diameter, lumps, coarse sand, noxious weeds, sticks, brush or other litter. Topsoil as delivered to the site or stockpiled shall have pH between 6.0 and 7.0 and shall contain not less than 5 percent or more than 8 percent organic matter as determined by loss of ignition of moisture-free samples dried at 100 degrees Celsius. The topsoil shall meet the following mechanical analysis:

	PERCENTAGE FINER
1-in screen opening	100
No. 10 mesh	95 to 100
No. 270 mesh	35 to 75
0.002 mm*	5 to 25

* Clay size fraction determined by pipette or hydrometer analysis.
Place a minimum of 4 inches of loam.

Starter Fertilizer

Starter fertilizer shall bear the manufacturer's name and guaranteed statement of analysis, and shall be applied in accordance with the manufacturer's directions.
Starter fertilizer shall be Scott's Starter Fertilizer, or equal, with timed nitrogen release to prevent burning.

Lime

Lime shall be an agricultural type ground limestone.
Lime shall be pelletized type for prolonged time release to soil.

Lawn Seed

Seed shall be of the previous year's crop.

Required ranges:
Purity > 90%
Germination > 80%
Crop < 0.5%
Weed < 0.3%
Noxious Weed – 0%
Inert < 8%

The standard seed mixture shall be applied at a minimum rate of 4 lbs./1,000 sf.
Grass seed shall conform to the following mixture in proportion by weight and weed content and shall pass the minimum percentages of purity and germination as indicated for same.

LAWN AREA SEED MIX	% WEIGHT
"Rebel II" Tall Fescue	70%
"Baron" Kentucky Bluegrass	10%
"Palmer" Perennial Ryegrass	20%

All seed shall comply with State and Federal seed laws.

A sworn certificate indicating each variety of seed, weed content, germination of seed, net weight, date of shipment and manufacturer's name shall accompany each seed shipment. Responsibility for satisfactory results rests entirely on the Contractor.

Mulch

Shall be a specially processed 100 percent Virgin wood fiber mulch containing no growth or germination-inhibiting factors. Wood fiber mulch shall be Second Nature Regenerated wood fiber as by Central Fiber Corporation, Wellsville, KS or equal. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the material become uniformly suspended to form a homogenous slurry. When sprayed on the ground, the material shall allow absorption and percolation of moisture. Each package of the wood fiber shall be marked by the manufacturer to show the air dry weight content and not contain in excess of 10 percent moisture.

Preparation. The ground surface shall be fine graded and raked to prepare the surface of the loam for lime, fertilizer and seed.
Perform a laboratory soil test on the proposed loam before placing any lime, fertilizer, or seed. This work shall be in accordance with ASTM D5539.

Lawn Areas. Apply fertilizer and lime to the surface of the ground in accordance with the manufacturers' instructions, and based on the results of the certified soils test.
Place the seed using a drop or rotary spreader at the rate recommended by the seed manufacturer for the intended use of the lawn or grass area being restored.
After spreading the seed, lightly rake the surface to work the seed in. The surface shall then be rolled.

Maintenance. Maintain loamed and seeded areas by mulching, covering, netting, watering, cutting, and fencing until an acceptable stand of vegetation is approved by the Engineer.

The dressed and seeded areas shall be sprinkled with water as necessary from time to time. Signs and barricades should be placed to protect the seeded areas. After the grass has started to grow, all areas and parts of areas that fail to show a uniform stand of grass shall be seeded repeatedly until all areas are covered with a satisfactory growth of grass.

Guarantee Period and Final Acceptance. At the end of the guaranteed period, inspection will be made by the Engineer upon written request submitted at least 10 days before the anticipated date. Seeded areas not demonstrating satisfactory stands as outlined above, as determined by the Engineer, shall be renovated, reseeded and maintained meeting all requirements as specified herein.
After all necessary corrective work has been completed, the Engineer shall certify in writing the final acceptance of the seeded areas.

LANDSCAPING

General
Products/Materials
Construction
Maintenance
Final Acceptance

General. The Contractor shall provide all operations pertaining to the planting and maintenance of trees, shrubs, ground cover, perennials and annuals.

Products/Materials.

Plants.

A complete schedule of plants, including quantities, sizes, and other requirements, is shown on the Landscaping Drawings. The Contractor shall furnish all types of plants that are listed on the schedule. In the event of plant count discrepancy between the Plant Schedule and the plants counted on the Drawings, the Drawings shall prevail. Discrepancies between the Plant Schedule and the Drawings shall not entitle the Contractor to claim any additional compensation, nor relieve him of the obligation to complete the Work shown on the Drawings.

No substitutes shall be accepted, except with the written permission of the Engineer. The Contractor shall submit all substitution requests, noting the source of plants, location, size, and condition, within thirty (30) days of receiving the Notice to Proceed.

Each plan shall have a durable legible label with plant size and name (genus, species, variety, cultivar) securely attached when delivered and in place until after acceptance. Labels shall not girdle or damage plants.

All plants shall be true to species and variety specified and nursery grown in accordance with good horticultural practices. All plants shall be packed, transported, and handled with utmost care to ensure adequate protection against injury or damage to the root ball, and desiccation. Plants must be protected from excessive vibrations. Plants shall not be thrown or bounced off a truck or loader to the ground. Plants shall not be dragged, lifted, or pulled by the trunk or braces in a manner that will damage the branches or loosen the roots in the ball. Plants material transported in vehicles shall be protected from wind whipping either by use of covered vehicle or secure tarps.

The Engineer shall make periodic inspections prior to and during the installation and maintenance periods of the Work. All plants shall be inspected upon delivery to the job site whereupon the Engineer has the right to reject unacceptable plant material. Should plant materials observed not be in keeping with the Drawings, details, and these Specifications, the Engineer will direct the Contractor to correct by repair and/or replacement as appropriate. All rejected plant materials shall be immediately removed from the site and replaced with specified material at no additional cost to the Owner. The Engineer shall be the sole judge of the conditions of quality and acceptability and will direct all corrections in writing to the Contractor.

Mulch

Mulch shall consist of shredded bark mulch, wood chips or rock mulch as specified on the drawings. Material shall be uniform in size, color, quality and overall appearance. Mulch shall be free of material injurious to plant growth. Sources of mulch should be free of weeds and invasive plant parts or seeds. Sawdust, dirt, garbage, or other debris mixed in the mulch is not acceptable. See Mulch Specification in Section Loam and Seed within this specification package. Contractor shall submit two pounds of proposed mulch for inspection by Engineer.

Construction. Contractor shall notify Engineer five (5) working days prior to delivery of plant material to the site. Engineer shall inspect plant material prior to off-loading.

Planting shall be done when temperatures are above freezing, the ground is frost free, and the soil is in a workable condition. Unless otherwise specified in writing by the Engineer, planting of trees shall be done between May 1 and October 1.

The Contractor shall mark all planting areas with stakes or paint. The Engineer shall approve the layout before planting begins. Contractor shall not stage planting operations on sidewalks.

The Contractor shall obtain a utility locate and ensure that utility marking is complete before any excavation begins. The Contractor shall locate and subsurface improvements such as sprinkling system or conduits. The Contractor shall be responsible for all damage resulting from neglect or failure to comply with this requirement.

Maintenance. The Contractor shall furnish all labor, materials, supplies and equipment required to establish, maintain, and protect the planted and seeded areas, for a guaranteed period (typ. 1 year grow period). However, maintenance activities shall commence immediately after each item is planted or when areas have been seeded. The Contractor shall supply a maintenance schedule to the Engineer, thirty (30) days prior to the landscape inspection. The Contractor shall also be responsible for protection of his work during the maintenance period, and shall repair and replace all materials and seeded areas damaged or destroyed within the scope of Work, regardless of cause. Contractor shall replace any tree or shrub damaged by a lawnmower, weed whip or other equipment at no additional cost to the Owner.

Contractor shall supply a proposed watering schedule to the Engineer thirty (30) days prior to installation of plant materials.

Final Acceptance. A Final Acceptance Inspection of the project will occur after completion of the one year plant establishment period. Conditions governing final acceptance of the planted and seeded areas are that, in the opinion of the Engineer, all plants are in a live, uniform, and sound and healthy and flourishing condition; free of disease, insect infestation and physical damage, and free of weeds, rubbish and construction debris. If the Engineer does not accept the improvements, the Contractor shall correct all deficiencies until acceptance is received from the Engineer. All costs associated with correcting the deficiencies shall be paid by the Contractor without additional cost to the Owner.

CONCRETE WORK

General
Cement
Admixtures
Water
Fine Aggregate
Coarse Aggregate
Samples of Aggregate
Classes of Concrete
Quality and Proportioning of Concrete
Determining Proportions
Consistency of Concrete
Measuring Materials
Mixing Concrete
Ready-Mixed Concrete
Forms
Embedded Work in Concrete
Placing Concrete
Curing and Protection
Finishing Concrete
Trimming and Repairs
Expansion Joints
Construction Joints
Weep Holes

General. The Contractor shall furnish all necessary materials and build all concrete masonry required under this contract and not otherwise provided for, as indicated on the drawings and as herein specified including recommendations presented in the "Geotechnical Engineering Recommendations, New Parking Garage, Olive Street, Greenfield, Massachusetts" by O'Reilly, Talbot & Okun dated, February 23, 2017.

All concrete shall be site-mixed or ready-mixed as produced by a plant acceptable to the Engineer.

Cement. Cement shall be a single brand of approved, American-made Portland Cement conforming to the ASTM Standard Specifications for Portland Cement, Designation C150, for Type II cement, or, with written permission of the Engineer Type III (high-early strength) cement.

When used in the work, cement shall be free from lumps and partially or wholly set cement.

No cement shall be used without prior approval of the Engineer.

If required, the Contractor shall furnish sworn certificate of mill tests of cement, in triplicate, at least seven days before the cement will be used. The Owner reserves the right to make such independent tests as he may deem necessary at any time.

When high early strength concrete is required, it shall be obtained by using Type III or by adding 15% additional Type I or Type II.

Admixtures. The use of admixtures shall meet MHD Standard Specifications as specified in Section M4.02.05 of the "Standard Specifications for Highways and Bridges," Commonwealth of Massachusetts, Department of Public Works, 1988 Ed. as amended and corrected.

Water. For mixing concrete, the Contractor shall use clean water from an approved source.

Fine Aggregate. Fine aggregate shall be clean, sound, sharp, screened, and well-graded sand conforming to the ASTM Standard Specifications for Concrete Aggregates, Designation C33, and the additional requirement that the aggregate shall have not less than 15 percent more than 30 percent, by weight, passing No. 50 sieve.

No fine aggregate shall be used if it contains more than two percent of silt or which shows a color darker than Plate 2 when tested according to the ASTM Standard Method of Test for Organic Impurities in Sands for Concrete, Designation C-40.

The weight average loss when fine aggregate is subjected to five cycles of the soundness test using magnesium sulfate shall not exceed 10 percent.

Coarse Aggregate. Coarse aggregate shall be washed, hard, tough and durable screened gravel or crushed stone conforming to the ASTM Standard Specifications for Concrete Aggregates, Designation C33 and the additional requirements specified herein. Coarse aggregate shall have not more than five percent by weight of deleterious substances and soft fragments. Unless otherwise approved, aggregate shall be well graded and shall conform to the grading requirements for coarse aggregates for nominal size 1 inch to No. 4.

No coarse aggregate shall be used if it contains more than one percent of silt or which shows a color darker than Plate 1 when tested as above specified for fine aggregate.

The weighted average loss when coarse aggregate is subjected to five cycles of the soundness test using magnesium sulfate shall not exceed 14 percent.

Samples of Aggregate. As required, the Contractor shall submit clearly labeled samples of fine and coarse aggregates to the Engineer. No aggregates shall be delivered and used shall be equal to the approved samples in all respects.

Classes of Concrete. 4000 psi concrete shall be used for all concrete not otherwise specified or noted on the drawings.

Quality and Proportioning of Concrete. Materials for concrete shall be proportioned to produce a thoroughly workable, plastic mixture resulting in a dense watertight concrete. The concrete shall meet MHD Standard Specifications as specified in Section M4.02.00 of the "Standard Specifications for Highways and Bridges," Commonwealth of Massachusetts, Department of Public Works, 1988 Ed. as amended and corrected.

The use of an approved additive other than air-entrained additives shall not affect a change in the maximum water-cement ratio or the minimum cement content. The minimum cement content can be changed only with the prior written approval of the Engineer.

Determining Proportions. The proportions of cement, fine and coarse aggregate and water to be used to obtain the specified concrete shall be determined by trial at the site. Proportions may be varied as approved, and shall be varied as required, provided that, in no case, shall the resulting mix violate the limitations set forth above under the heading "Quality and Proportions of Concrete."

Consistence of Concrete. Concrete shall be of plastic consistency such that it can be work readily into all parts of the forms and around embedded work without segregation of constituent materials or collection of free water on the surface.

Measuring Materials. Cement, fine aggregate, coarse aggregate and water for concrete shall be measure separately and with accuracy. Particular care shall be taken that fractional bags of cement are correctly measured. Aggregates shall be measured by weight or loose in approved boxes, with allowance as directed for bulking of sand. Water shall be measured by volume.

Mixing Concrete. Concrete shall be mixed in an approved batch mixer of suitable capacity except for small quantities, which, by permission, are hand mixed. The volume of the mixed batch shall not exceed the manufacturer's rated capacity of the mixer. Adequate facilities shall be provided for accurate measurement of water and the control of materials entering the drum. The mixer shall revolve at a uniform peripheral speed of above 200 rpm.

The minimum mixing time for each batch (from the time when all solid materials and water are first in the drum) shall be 1-½ minutes for mixers of 1 c.y. capacity or less; for mixers of larger capacity, the mixing time shall be increased 30 seconds for each additional half cubic yard or fraction thereof. The entire batch shall be discharged before the mixer is recharged.

If the concrete is mixed by hand, it shall be done on a suitable surface. The cement and aggregates shall be mixed dry until an even and uniform color has been attained throughout. The proper quantity of water shall then be added and the whole mass turned with square-edged shovels until it has become intimately mixed.

Ready-Mixed Concrete. The use of ready-mixed concrete will be permitted provided that the Engineer shall have the right to inspect the plant of the manufacturer and the proportioning and mixing of the concrete and shall be given every facility therefore, and that the materials and methods of proportioning, mixing and delivering are satisfactory and generally in accordance with the above specifications. The manufacturer shall furnish, from an Independent testing laboratory and through the Contractor, appropriate certificates of tests, materials, proportions mixing and strengths. Such certificates shall have an effective date not more than six months prior to the time when the concrete will be used and shall be furnished to the Engineer at least seven days before the time of use. No ready-mixed concrete shall be ordered before the Engineer has given his approval thereof.

The quantity of concrete to be mixed or delivered in any one batch shall not exceed the rated capacity of the mixer or agitator as stated on the nameplate for the type of mixing in use.

At the time of delivery of each load of concrete, the Engineer shall be given a slip stating the actual quantity of each ingredient in that load.

Attention is directed to the importance of dispatching trucks from the batching plant so that they shall arrive at the site of the work just before the concrete is required, thus avoiding excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms. Concrete shall be discharged into forms within 1 ½ hours after water was first added to the mix, and shall be mixed at least five minutes after all water has been added.

Forms. Forms shall be constructed of sound lumber, plywood or metal and shall conform accurately to the dimensions, shapes and elevations indicated on the drawings. They shall be mortar-tight, rigid and unyielding during the placing and compacting of the concrete. The Contractor shall be entirely responsible for the adequacy. Forms for manhole inverts shall be smooth, carefully built to true size and shape and accurately set.

Suitable molding or bevels shall be placed so as to produce a ¾ inch chamber on all exposed projecting corners.

Form surfaces to be in contact with concrete shall be oiled, and if reused, shall first be cleaned, repaired and re-oiled.

Forms shall not be removed until the product of the elapsed number of days after placement and the average daily air temperature at the surface of the concrete equal 100 for walls and vertical surfaces and 500 for slabs.

Embedded Work in Concrete. All embedded work shall be accurately built into or encased in the masonry by the Contractor as directed and all necessary precautions shall be taken to prevent such work from being displaced or deformed.

Placing Concrete. No concrete shall be placed on frozen subgrade or in water. Forms and excavations shall be free from water and all dirt, debris and other foreign matter when concrete is placed.

If chutes are used for conveying concrete, they shall be of metal or shall be metal lined.

Concrete shall be deposited in suitable layers, one layer quickly following another until the placement has been completed. While being deposited, the concrete shall be thoroughly compacted by rodding and spading or by mechanical vibration. If mechanical vibration is used, the concrete consistency as measured by slump shall not exceed 3 inches. Vibration shall be done by experienced operators under close supervision and the duration shall be held at the minimum necessary to produce thorough compaction without segregation. Hand spading shall always be used adjacent to forms to produce a smooth, dense surface. The concrete shall be thoroughly and carefully rodded about embedded materials.

Curing and Protection. Water shall not be permitted to rise on concrete within 24 hours after it is placed, nor shall running water be allowed to flow over complete concrete within four days after it has been placed.

For at least seven days after having been placed, all concrete shall be so protected that the temperature at the surface will not fall below 50 degrees F. The methods of protecting the concrete shall be as specified and shall be subject to approval.

Finishing Concrete. Manhole tables and all surfaces shaped without forms and over which liquids will flow shall be smoothly finished by means of a steel trowel without the use of additional cement of sprinkling with water. Troweling shall not be started until all water has disappeared from the surface. Over troweling shall be avoided.

Trimming and Repairs. It is expected that forms, concrete and workmanship shall be such that the quantity of trimming and repair work is kept to a minimum.

Defective concrete shall be cut normal to the surface until sound concrete is reached, but not less than one inch deep; the remaining concrete shall be thoroughly roughened and cleaned. Concrete around the cavity or the form-tie recess shall be thoroughly wetted and promptly painted with a 1/16-inch brush coat of neat cement mixed to the consistency of thick lead paint. The hole shall then be filled with mortar mixed in the proportions of one part cement and 1 ½ parts sand, both being form the same sources as in the apparent concrete.

Expansion Joints. Performed expansion joints shall be ½" bituminous impregnated expansion joint filler, type conforming to ASTM D994, or approved equal place where shown on the plans. The joint filler material shall be placed according to the manufacturer's recommendations. The joint filler material shall be placed such that it's top surface is one inch below the top surface of the new concrete.

Joint sealant shall be a multi-component polyurethane type and shall comply with ASTM C920, Class 25. Joint sealants shall be installed according to the manufacturer's recommendations. The Contractor shall supply smooth #35 bar dowels at all expansion joints and install the dowels, with expansion caps, 18" on center. Dowels shall be a minimum of 14" long. Depth of the dowels not shown of the plans or specified shall be as directed by the Engineer.

Expansion joints for retaining walls shall be placed 90' on center maximum, intermediate construction joints shall be placed 30' on center maximum.

Construction Joints. All construction joints in retaining walls shall be provided with a keyway and a waterstop. Keyway shall be as indicated on the plans or as specified by the Engineer.

The waterstop material shall be a minimum of 5" wide and of type, size and configuration approved by the Engineer. All waterstop material shall be installed in accordance with manufacturer's instructions and special care shall be taken in jointing the material. Waterstop shall be a diaphragm type of multirib design thermo-plastic material unless otherwise specified.

Concrete in structures shall be placed in such a manner that all construction joints shall be exactly horizontal or vertical, as the case may be, and that they shall be straight and as inconspicuous as possible.

When construction joints are definitely shown on the plans, all concrete between consecutive joints shall be placed in a continuous operation.

In order to allow for shrinkage, concrete shall not be placed against the second side of the construction joints for at least 12 hours after that on the first side has been placed.

Weep Holes. Weep holes shall be provided through all structures as indicated on the plans and as directed. Ends of weep holes that are to be covered by filling material shall be protected by ¼" mesh galvanized wire screen 23 gauge and not less than one (1) cubic yard of crushed stone.

Pipe for weep holes shall be 4" PVC pipe SDR 35 or approved equal, and shall have a minimum pitch of 1/8" per foot.

PAVEMENT MARKINGS

PART 1 – GENERAL

1.01 DESCRIPTION OF WORK

A. The work includes preparation of surfaces and furnishing and applying paint for pavement and curb markings, traffic stripping, directional arrows and messages.

1.02 QUALITY ASSURANCE

A. Provide paint which is compatible with substrate material.

B. Codes and Standards: Conform to state requirements for volatile organic compound (V.O.C.) contents where applicable.

1.03 SUBMITTALS

1. Submit manufacturer's technical information in standard printed published form, including performance criteria and application instructions for each material proposed for use.

2. List each material and cross reference to the specific paint and finish system and application. Identify by manufacturer's catalog number and general classification.

1.04 JOB CONDITIONS

A. Weather: Apply traffic paint only when the ambient air temperature is 40 degrees Fahrenheit or higher and the temperature on the surface to be painted is 45 degrees Fahrenheit or higher. If pavement is wet, allow the surface to dry for a minimum of eight hours after it appears surface dry.

B. Protection of the work: Exercise care to prevent paint from dripping on the pavement, curb and sidewalks, and remove any drippings or spillage before they harden. Protect adjoining surfaces against over-spray or paint splash stains, throughout painting operations.

C. Traffic Maintenance: Furnish, install and maintain traffic cones, barricades, lights and other protective devices required to protect traffic, workmen and completed pavement marking and striping, and remove when marking and striping, including painted sections of curbing and raised traffic bars, have set and hardened to such degree that they will not be damaged.

D. Scheduling of the Work: Schedule marking and striping operations to permit paint to set and harden before the area is to be opened to traffic.

PART 2 – PRODUCTS

2.01 TRAFFIC AND PARKING STALL MARKINGS

A. Products offered by manufacturers to comply with the requirements include the following:

1. Franklin Paint, Fast Dry Waterborne Traffic Paint, item# 2015, Yellow 1952E or item# 2014, White 1952E.

2. Sherwin Williams, Hotline Fast Dry Latex Traffic Marking Paint, TM2153 LF Yellow TTP-1952D or TM2152 White TTP-1952D.

3. Or approved equal

B. Paint Application

1. First Coat: Latex Acrylic Emulsion 15 mils wet coat; yellow (AASHTO Designation M248, Traffic Type II Paints)

2. Second Coat: Same as first.

PART 3 – EXECUTION

3.01 EQUIPMENT

A. 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.

3.02 LAYOUT OF THE WORK

A. Provide sufficient control points to permit application of stripes, directional arrows, messages, crosswalk marking, and parking space delineations as shown on the drawings.

1. Locate and layout marking in a manner that will not interfere with adhesion of point or leave permanent non-specified markings.

3.03 APPLICATION

A. Surface Conditions: Do not apply paint to new bituminous pavement until 24 hours after pavement has been placed. On new Portland Cement concrete pavement, do not apply paint until the pavement has been allowed to cure for a minimum of seven days.

B. Cleaning: Clean the surface of areas to be painted of dust, dirt, laitance, oil, and other foreign substances detrimental to paint adhesion.

C. Paint directional arrows, parking stalls, marking lines, etc., to be as detailed on the Drawings. Unless otherwise detailed, single line width to be four (4") inches wide. Striped areas shall be four (4) inch wide lines eighteen (18) feet on center. Lay out all painted lines and define with chalk markings for approval before proceeding with painting.

D. Painting:

Apply paint only during daylight hours. Except for special area and markings requiring hand painting, apply all pavement marking by machine.

2. Suspend painting operations when wind conditions are such that blowing of spray-applied paint and deposit of dust on newly applied paint is likely.

3.04 CORRECTIVE MEASURES

A. 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.

END OF SECTION

CLOSEOUT

Summary. Section includes:

a. Documentation required for the transfer of the completed Work to the Owner
b. Final Cleaning

Submittals.

a. Evidence of payment and release of liens
b. List of Subcontractors

Substantial Completion. Refer to General Conditions, for procedures relating to obtaining Substantial Completion.

Project Closeout Documents. Provide evidence of payment and release of liens.

Provide list of Subcontractors including names, addresses, and telephone numbers where they can be reached for emergency service at all times including nights, weekends, and holidays.

Final Payment. Refer to General Conditions, for procedures relating to final inspection and payment.

The Contract shall be considered complete and final payment made, only when:

a. All provisions of the Contract Documents have been strictly adhered to.
b. The project and premises have been left in good order, including removal of all temporary construction, Contractor-owned and extraneous materials.

Cleaning. Remove and entirely dispose of material or debris that has washed, flowed or has been placed in existing watercourses, ditches, gutters, drains, pipe, or structures, for work done under the Contract work limits. Leave ditches, channels, drains, pipes, structures, and watercourses in a clean and neat condition upon completion of the Work.

Restore or replace any public or private property damaged or removed during the course of the Work. Property shall be returned to a condition at least equal to that existing immediately prior to the beginning of operations. Complete all highway or driveway, walk, and landscaping work using suitable materials, equipment and methods. Perform restoration of existing property, signs or structures promptly as work progresses; do not leave restoration work until the end of the Contract Time.

SECTION 02300
EARTHWORK

PART 1 - GENERAL

1.1 INTRODUCTION

A. This section specifies requirements for the earthwork portion of the project, including the placement fill beneath pavements and foundations (including the load transfer pad above Rigid Inclusions).

B. Subsurface information is provided in the project geotechnical report entitled "Geotechnical Engineering Recommendations, New Parking Garage, Olive Street, Greenfield, Massachusetts, dated February 23, 2017, prepared by O'Reilly, Talbot & Okun Associates, Inc.

C. It is noted that concrete foundation walls and footings from a former site building remain along the western (adjacent to the 45 Bank Row structure) and southern (along Olive Street) sides of the site. The walls and approximately 12-inches wide, and footings are approximately 36-inches wide. They extend to a depth of approximately four feet below the existing ground surface. These walls and footings are within the footprint of the new parking garage and need to be removed in their entirety, and the excavations backfilled with sand and gravel. The cost of this work shall be included in the Contractor's bid. It is noted that other walls and footings may be present beneath the site. If these buried structures are encountered during construction, it may be necessary to remove them. If instructed to do so by the Owner, the extra cost to remove of any unidentified buried walls or footings will be compensated on a negotiated extra cost basis.

D. A stone culvert is located beneath the site. This culvert will be decommissioned as part of the project. Portions of the culvert will need to be removed as part of the project, to allow for the installation of the Rigid Inclusions. The limits of the areas where the culvert will need to be removed are shown on the plans. The contractor shall include the cost to excavate and remove the line and backfill the excavation in his bid.

1.2 SCOPE OF WORK

A. Prior to the start of construction, the General Contractor shall conduct a Preconstruction Condition Survey of residential buildings abutting the site.

B. The Contractor shall clear and grub the entire building footprint and strip pavement, sidewalks, and topsoil from the building subgrade. All trees and stumps shall be removed in their entirety.

C. The Contractor shall remove the former building foundations in the southwest portion of the site and the stone culvert as shown on the plans.

D. Following the installation of Rigid Inclusions in accordance with the requirements of Section 316600, the Contractor shall proof compact the existing soil subgrade within the building pad area and construct the Load Transfer Pad as required by the design prepared by the Rigid Inclusion specialty contractor.

E. The Contractor shall use suitable soil from off-site sources as fill to achieve final grades.

F. The Contractor shall make excavations in such a manner and to such widths that they will give suitable room for performing the Work and shall furnish and place all sheeting, bracing and supports as necessary.

G. The Contractor shall control erosion, groundwater and surface water run off such that the excavations and areas of fill placement are firm and dry and in all respects acceptable. The Contractor shall prevent the migration of sediment off site, and collect and properly dispose of all discharge water in accordance with local and state requirements and permits.

H. The Contractor shall backfill the site to the final grades and compact the subgrade in intermediate layers to the requirements set forth in this Section.

1.3 SECTION INCLUDES

A. Submittals.

B. Products.

C. Excavation and shoring or bracing as necessary.

D. Excavation and placement of Fill Materials.

E. Backfilling and Compaction.

F. Grading.

G. Geotechnical Engineering Testing.

1.4 RELATED SECTIONS

A. Section 316600, Ground Improvement by Rigid Inclusions

1.5 DEFINITIONS

A. Compaction: The tamping and rolling of all backfill placed in uniform horizontal layers not exceeding a defined uncompacted lift thickness.

B. “In-the-dry”: In-situ moisture content of no more than two percentage points above the optimum moisture content.

C. Proof-rolling: The tamping and rolling of all subgrades and processed material not exceeding a defined uncompacted lift thickness.

D. Unsuitable material: Material containing vegetation or organic material, such as mulch, peat, organic silt, topsoil sod, deleterious material, and/or particles greater than 4 inches in diameter, that are not satisfactory for use as determined by the Geotechnical Engineer.

1.6 SUBMITTALS

A. Prior to transporting any material to the site, the Contractor shall submit the name of imported material suppliers. These suppliers shall provide materials from same source throughout the work. Change of source suppliers shall require approval from Owner and the Engineer.

B. Soil samples of each proposed material shall be submitted, in airtight containers, to the Geotechnical Engineer. Samples shall consist of a 50 lb. sample of each type of fill and shall be delivered to the Engineer and Owner two weeks prior to start of construction activities.

C. Grain-size distribution analysis test data shall be delivered with the samples. The analysis shall be performed in accordance with ASTM D422.

D. Moisture-density curve data indicating the maximum dry density and optimum moisture content as determined by ASTM D1557 for each proposed source of backfill shall be submitted to the Geotechnical Engineer.

E. The Contractor shall submit to the Geotechnical Engineer and Owner, manufacturer's literature and data on proposed compaction equipment.

1.7 QUALITY CONTROL

A. Inspection and testing will be performed by the Contractor to ensure that the materials placed meet the requirements in this section. Fill materials imported from off site sources shall be chemically and geotechnically tested once for every 2,000 tons of material.

B. If fill soils are not obtained from a commercial gravel pit, the Contractor shall provide certified analytical testing of off site backfill to demonstrate that the soil does not exceed the limitations for MCP reference/reportable concentrations. Analytes shall include RCRA-8 metals, Extractable and Volatile Petroleum Hydrocarbons (EPH/VPH), and Volatile Organic Compounds (by EPA Method 8260B/5035).

C. Tests and analysis of soil material will be performed in accordance with ASTM D422, ASTM D1557, ASTM D2922, ASTM D3017 and ASTM D4318.

D. If tests indicate materials do not meet specified requirements, the Contractor shall identify an alternative borrow source, test the new material, and submit results to the Geotechnical Engineer at no cost to Owner.

1.8 LAYOUT AND GRADES

A. The Contractor shall establish permanent bench marks and replace as directed any, which are destroyed or disturbed. The Contractor shall maintain sufficient reference points at all times during construction to properly perform site grading. The existing survey benchmark shall be protected throughout the construction project.

B. Finished grades, contours, and elevations indicated on the Drawings describe final surface elevation for completed construction. The words "finished grade" as used herein shall mean final grade elevations indicated on the Drawings. Spot elevations shall govern over proposed contours. Where not otherwise indicated, project site areas shall be given uniform slope between points and existing established grades.

1.9 QUALITY ASSURANCE

A. Field inspection and testing may be performed by the Geotechnical Engineer at the Owner's expense to supplement the Contractor's Quality Control testing. Classification of all materials will be made by the Geotechnical Engineer whose decision shall be final and binding on the Contractor.

B. The Contractor shall be responsible for managing and tracking all materials excavated and placed in stockpiles for testing.

C. The Contractor shall perform in place density tests in accordance with ASTM D2922 or D3017 as the Work progresses, to determine the degree of compaction. Any corrective work required as a result of such tests, such as additional compaction, or a decrease in the thickness of layers, shall be performed by the Contractor at no additional expense to Owner. In place density testing shall be made at the Contractor's expense by a qualified geotechnical testing laboratory.

D. The Engineer's duties do not include the supervision or direction of the actual work by the Contractor, his employees or agents. Neither the presence of the Engineer nor any observation and testing by the Geotechnical Engineer shall excuse the Contractor from defects discovered in his Work at that time or subsequent to the testing.

E. Subgrades shall be approved for compactness and material composition prior to placing subsequent lifts. If inspections indicate Work does not meet specified requirements, the work shall be removed, replaced, and compacted at no additional cost to Owner.

1.10 REGULATORY REQUIREMENTS

A. All excavations shall comply with the requirements of OSHA excavation safety standards (29 CFR Part 1926.650 Subpart P), State, and local requirements. Where conflict between OSHA, State, and local regulations exists, the most stringent requirements shall apply.

PART 2 PRODUCTS

2.1 GENERAL

A. Sand and Gravel Fill shall be a natural soil obtained from an off-site commercial source. It shall be free of ice, snow, roots, sod, rubbish, oil, hazardous material and other deleterious or organic matter. It shall be graded within the following limits:

U. S. Standard Sieve Size	Percent Finer by Weight
4 inch	100
½ inch	50-85
No. 4	40-75
No. 40	10-35
No. 200	0-8

B. Gravel Base Course Fill will be used beneath pavements and to construct the Load Transfer Pad. It shall be a natural soil obtained from an off-site commercial source. It shall be free of ice, snow, roots, sod, rubbish, oil, hazardous material and other deleterious or organic matter. It shall be graded within the following limits:

U. S. Standard Sieve Size	Percent Finer by Weight
4 inch	100
½ inch	50-85
No. 4	40-75
No. 10	30-60
No. 40	10-35
No. 100	5-20
No. 200	0-8

C. Granular Fill shall be a natural soil obtained from an off-site commercial source. It shall be free of ice, snow, roots, sod, rubbish, oil, hazardous material and other deleterious or organic matter. It shall be graded within the following limits:

U. S. Standard Sieve Size	Percent Finer by Weight
4 inch	100
No. 10	30-90
No. 40	10-70
No. 200	0-15

D. Sand and Gravel, Gravel Base Course, and Granular Fill materials obtained from off-site sources shall be acceptable for use only when accompanied by an LSP Opinion stating that the soils do not contain detectable quantities of oil and/or hazardous materials.

E. Crushed Stone shall be durable crushed rock or crushed gravel stone, free of ice, snow, sand, silt, clay, loam, shale, or other deleterious matter, graded within the following limits:

Sieve Size	Percent Finer by Weight
1 inch	100
3/4 inch	90-100
1/2 - inch	10-50
3/8 - inch	0-20
No.4	0-5

F. Dense-graded crushed stone shall consist of hard, durable particles of stone or gravel and natural or crushed sand that conforms to section M2.01.7 of the Standard Specifications and shall conform to the following grade requirements:

Sieve Size	Percent Finer by Weight
3 inch	100
1-1/2 inch	70-100
3/4 inch	50-85
No.4	30-55
No. 50	8-24
No.200	3-10

PART 3 EXECUTION

3.1 EXCAVATION AND GRADES

A. Place erosion control measures including the straw bales and silt fence prior to the intrusive work activities.

B. Contractor shall strip the subgrade of pavement, concrete slabs and unsuitable materials, and place or excavate fill materials to the grades shown on the Drawings.

C. Approximate limits of areas to be filled are shown on the Drawings.

D. Placement thickness criteria for Sand and Gravel, Gravel Base Course and Granular Fill shall be in accordance with paragraph 3.7 of this section.

E. Prior to the placement of any fill, the Contractor shall remove any unsuitable soils, as determined by the Engineer, and proof roll the existing site soils with at least four passes with a vibrating drum roller (weighing a minimum of 6,000 pounds).

3.2 GRADING

A. Clean Sand and Grave, Gravel Base Course, and Granular Fill (as specified in this Section) shall be imported to the site, and used for grading as shown on the Drawings and as directed by the Engineer.

B. The final ground surface shall be graded to the elevations shown on the Drawings.

3.3 BACKFILLING - GENERAL

A. The Contractor shall not commence backfilling operations without approval of the Engineer.

B. The contractor shall maintain a dry and firm subgrade throughout construction. Dewatering shall be performed as needed at the Contractor's expense.

C. Fill shall be placed in lifts no thicker than 9 inches and compacted to 95 percent of its maximum dry density as determined by ASTM D-1557

D. The Contractor shall strip the existing subgrade of any vegetation, topsoil, organics, debris or other unsuitable materials to the extent shown on the plans, and as required by the engineer. The subgrade shall be proof compacted using a vibratory roller to treat any loose or disturbed areas, and to provide a dense uniform surface.

E. After the subgrade has been prepared, fill material shall be placed and built-up in successive layers until the required elevations are reached. No fill shall be placed on a frozen surface, nor shall snow, ice, or other frozen material be included in fill. Wet materials containing moisture in excess of the amount necessary for satisfactory placement or compaction shall not be used.

F. All fill shall be brought up in essentially level lifts and shall be placed in levels by standard methods. Layers of fill shall not exceed nine inches in uncompacted thickness before compaction, unless otherwise specified, or as required for proper subgrade stabilization.

G. Filling operations shall continue until the fill has been brought up to the finished slopes, lines, and grades making proper allowances for thickness of the overlying topsoil

H. The entire surface of the work shall be maintained free from ruts and in a condition that will permit construction equipment to travel over any section readily. The top surface of each layer shall be made level or slightly sloped toward the center of the filled area.

I. Backfilling shall not be performed when weather conditions or the conditions of the materials are such that, in the opinion of the Geotechnical Engineer, work cannot be performed satisfactorily.

3.4 MOISTURE CONTROL

A. Moisture in fill materials shall be at or near optimum moisture content. Moisture control shall be within the range of +1 to -3 percent of optimum. This standard shall apply to all compacted fill regardless of the method of compaction used. If the Geotechnical Engineer determines that the fill material to be used is excessively wet, the Contractor shall dry the material.

B. If, in the opinion of the Geotechnical Engineer, additional moisture is required, water shall be applied by sprinkler tanks or other uniform distribution devises. If excessive amounts of water or if rain should cause excessive wetness, the area shall be allowed to dry as provided above.

3.5 COMPACTION

A. No compaction shall be done when the material is too wet. If the compacted surface of the fill layer is determined to be too smooth to provide an adequate bond with the succeeding layer, the layer shall be loosened by scarifying or disked to allow interlocking with the overlying lift.

B. Each layer of Fill material shall be compacted to secure a dense, stable, and thoroughly compacted mass.

C. If at any time, the Engineer judges the degree of compaction being obtained is insufficient; the Engineer may at her/his discretion order that a compaction test be taken. Tests in each area shall be performed at the Contractor's expense. No less than three tests per lift will be conducted in each area to confirm that adequate compaction has been achieved. Areas found to be deficient in degree of compaction shall be reworked, recompacted, regraded, and retested if required, at the sole expense of the Contractor.

D. Compaction of Fill shall be in accordance with Paragraph 3.7.

3.6 FINISHED GRADES

A. All areas covered by the project, including excavated and filled areas and adjacent transition areas shall be uniformly graded so that finished surfaces are graded to meet the surrounding topography. Areas to receive future topsoil shall be graded to allow for such material.

B. Grading shall be done by standard methods. Areas inaccessible to heavy grading equipment shall be graded by manual methods. Embankments shall be graded at all times to ensure runoff of water.

C. Final grading shall be performed in such manner as to provide proper drainage from the project site. Finished grades shall be pitched to drain away from structures completed under this Contract. In no case shall drainage from the project site be so altered or controlled as to result in damage or the potential for damage, to adjacent property, or to any portion of the Work executed under this Contract from erosion or flooding.

3.8 LIFT THICKNESS AND COMPACTION REQUIREMENTS

A. Fill material may be placed in lifts up to 9 inches and compacted to at least 95 percent of the maximum dry density as determined by ASTM D1557.

B. Topsoil shall be placed in 6-inch lifts to finish grade, proof-rolled with two passes.

END OF SECTION

SECTION 02400
GROUND IMPROVEMENT BY RIGID INCLUSIONS

PART 1 GENERAL

1.1 INTRODUCTION

This Section specifies requirements for the construction of Rigid Inclusions (RI) as identified in the Plans and Specifications for the Project, as well as quality control testing and performance testing. Rigid Inclusions are columns of grout or concrete used to reinforce the ground to increase bearing capacity and reduce settlement of the subject parking garage structure. Rigid Inclusions are constructed with a drilling tool that displaces soil laterally, producing very little spoils. The intent of the Rigid Inclusions program specified herein is to aid in supporting the applied loads and control the settlement to less than the specified maximum values. The Contractor shall furnish all supervision, labor, material, equipment, and related services necessary to perform the work.

1.2 SCOPE OF WORK

In general, the scope of the work including the main tasks required to perform the work.

A. General Description: The work shall consist of designing, construction, monitoring, and testing of RIs as identified in this specification within the limits indicated on the 5/10/17 Precast Package and 5/10/17 Site & Utility Relocation Package. In particular, reference drawing numbers S-002 & S-101 for design loading conditons. RIs work shall meet the acceptance criteria presented in the following sections of these specifications.

B. Overview of Tasks: In connection with the RI program, as shown on the drawings, the RI Contractor shall provide all labor, materials, and equipment to accomplish the following items of work:

1. Furnish and convey grout/concrete to RI locations.

2. Construction of RIs to the lines, grades, and criteria detailed on the approved RI Shop Drawings.

3. Load test a selected RI(s) to confirm design assumptions and demonstrate that they achieve the required load carrying capacity.

4. Monitor installation parameters utilizing a Data Acquisition System.

5. Trim RI tops to design elevations and backfill open hole with material designated by RI design engineer.

6. Complete QA/QC program.

C. Performance Responsibility: It shall be the RI Contractor's responsibility to determine and implement the systems to ensure that specified criteria is achieved.

1. RI design shall be sealed by a Professional Engineer in the State of Massachusetts, and compliance with the loads and performance specifications (provided by Structural Engineer of record) shall be the responsibility of the RI Contractor.

2. RI design shall provide details and construction requirements for the Load Transfer Platform.

D. Performance Criteria

1. Provide the specified bearing pressure/capacity of the garage footings of 9,000 pounds per square foot (psf).

2. Limit total static settlement of the foundation to one inch during service conditions, as described in the drawings and geotechnical report.

3. Limit differential static settlement of the foundation to 3/4 inch during service conditions, as described in the drawings and geotechnical report.

1.3 STANDARDS AND REFERENCES

All material testing to determine specification compliance will be provided by an independent testing agency retained by the Owner. Load testing to be performed by the Contractor.

A. Applicable Standards: The most recent version of the following testing methods or standards shall/may be employed:

1. ASTM C31: Standard Practice for Making and Curing Cement Test Specimens in the Field.

2. ASTM C39: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

3. ASTM C94: Standard Specification for Ready-Mixed Concrete.

4. ASTM C143: Standard Test Method for Slump of Hydraulic-Cement Concrete.

5. ASTM C150: Standard Specification for Portland Cement.

6. ASTM C172: Standard Practice for Sampling Freshly Mixed Concrete

7. ASTM C1064: Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete

8. ASTM D1143: Standard Test Methods for Piles Under Static Axial Compressive Load

9. ASTM D1194: Standard Test Method for Bearing Capacity of Soil for Static Load and Spread Footings

10. ASTM D3689: Standard Test Methods for Deep Foundations Under Static Axial Tensile Load

B. Reference Documents: Reference documents to be used by the RI Contractor shall include:

1. This specification,

2. Project Drawings, and

3. Project geotechnical report entitled “Geotechnical Engineering Recommendations, New Parking Garage, Olive Street, Greenfield, Massachusetts, dated February 23, 2017, prepared by O’Reilly, Talbot & Okun Associates, Inc.

1.4 DEFINITIONS

The key terms used in this specification are defined below.

A. **Rigid Inclusions (RIs):** Ground improvement by the use of Rigid Inclusions typically uses grout elements to reinforce weak or compressible strata; resulting in increased bearing capacity and reduced settlement.

B. **Displacement Tools**: Auger or Pipe tools specially designed to displace soil laterally while advancing or retracting the tool. The displacement tool creates very little spoil.

C. **Field Quality Control Representative (FQCR):** The individual, generally titled Superintendent or Field Engineer, given specific inspection and testing tasks identified in this specification.

1.5 FOUNDATION CONTRACTOR QUALIFICATIONS

A. The RIs shall be engineered and installed by an experienced specialty foundation contractor. The RI contractor shall provide evidence of the successful completion of a minimum of five RI projects of similar (or greater) size, and with similar soil conditions. Per Paragraph 1.6, a list of these projects shall be provided with the bid.

B. The RI Contractor's job superintendent shall have a minimum of two years of method specific experience.

C. The project manager shall have at least three years of experience in RI construction, with at least the last two years in the full-time employment of the RI Contractor.

1.6 SUBMITTALS

This section details all submittals required with the bid, prior to field work, during production work, and after the work is completed. The Contractor's design submittals shall be prepared and stamped by a Professionsl Engineer, licensed in the State of Massaachusetts.

A. Bid Time Submittals: The following shall be submitted to the Owner's representative by the RI Contractor with the bid documents:

   A list of at least five previously completed projects of similar scope and purpose for approval by the Owner's representative. The list shall include a description of the project, relative size, and contact person with phone number.

B. Pre-Field Work Submittals: The following shall be submitted to the Owner's representative by the RI Contractor two weeks prior to the start of the work:

   1. Resumes of the management, supervisory, and key personnel for approval by the Owner's representative.

   2. A ground improvement design based on information contained in the project geotechnical report, sealed by an engineer licensed in the state of Massachusetts the work to be performed that demonstrates that the program achieves the specified performance criteria provided in section 1.3 of these specifications. Design calculations and working drawings shall show conformance with the RI design performance criteria. Calculations shall include an evaluation of vertical and

horizontal displacements, as well as structural requirements for the RIs to resist loads at each structural column and wall location. The working drawings shall include requirements for the materials, compaction, lateral extent and thickness of the load transfer pad.

3. Description of the equipment to be used and a detailed discussion of the RI installation procedure.

4. Proposed grout/concrete mix design and a description fo the materials to be used.

5. Proposed RI reinforcing configuration and means, methods and sequence of installation.

6. A ground improvement QA plan, as detailed in section 3.4 of the specifications.

7. Work procedures and Quality Control criteria.

8. Load test details, including the number and location of tests, test layout and procedures, and loading increments.

9. A shop drawing for review indicating the spacing, location, and depth or installation criteria of RIs to achieve the criteria outlined in this specification.

10. Schedule of values.

11. Grout mix design.

12. Grout compression test results

C. During Production Submittals: The following shall be submitted to the Owner's representative by the RI Contractor during the work:

1. Accurate daily records of all RIs constructed as detailed in section 2.1.C.2 below.

2. Any change in the predetermined RI program necessitated by a change in the subsurface conditions.

3. Load test results, analysis of the data and recommendations for design parameters prepared by an engineer licensed in the state of Massachusetts.

D. Closeout Submittal: The following shall be submitted to the Owner's representative by the RI Contractor within 15 business days of the completion of the RI work.

1. As built drawings: Drawings documenting the as built conditions of the RI work.
2. A warranty document good for one year from the date of RI work completion.

PART 2 EQUIPMENT AND MATERIALS

2.1 EQUIPMENT

The equipment used to perform the RI construction may consist of the common construction equipment, specialty equipment and data acquisition system required to perform this work.

A. General: The RI Contractor shall supply equipment in good operating condition capable of performing the work specified herein.

B. Specific Equipment Capabilities: The choice of installation rig is largely dictated by site conditions and is left to the experience of the Contractor. The equipment shall be able to apply sufficient force and/or torque to penetrate to the design depth based on the subsurface conditions represented in the project geotechnical report. The installation tool shall be of sufficient length to reach the required depth.

   Grout/concrete shall be placed using suitable pumping equipment and through suitable tubing. The system shall have a means of determining the volume of grout delivered to the tooling at any time during construction.

C. Equipment Instrumentation: The RI Contractor shall provide gauges or other instrumentation (measuring devices) to provide real time measurement and recording through a date acquisition system of:

   1. RI number, start/finish time of installation, rate of penetration, crowd pressure and/or torque, depth of treatment (or tip elevation), neat volume based on depth of treatment and volume of grout placed.

D. Communication Equipment: An adequate communication system shall be maintained between the RI rig operator and the grout pump operator.

2.2 MATERIALS

The materials incorporated in this work shall meet the following minimum standards:

A. Portland Cement: Conforming to the ASTM Standard C150/C150M.

B. Fluidifier (if required): Shall be a compound possessing characteristics which will increase the fluidity of the mixture, act as water reducing agent and retardant.

C. Water: Shall be potable, fresh, clean and free of sewage, oil, acid, alkali, salts, or organic matter.

D. Fine and Coarse Aggregate: Fine and coarse aggregate shall conform to the requirements of the RI designer, subject to review by the Owner's structural engineer..

E. Reinforcing Steel: If required, reinforcing steel shall conform to the requirements of the RI designer.

F. Geogrid/Geotextile: Geogrid (if required per the RI designer) shall conform to and be installed in accordance with the manufactures specifications and guidelines, as per the details in the drawings.

G. Grout/Concrete Mixes: Grout/concrete for Rigid Inclusions shall consist of Portland cement, sand, and water, and may also contain coarse aggregate, a mineral admixture and/or approved fluidifier. The components shall be proportioned and mixed to produce a grout capable of maintaining the solids in suspension, minimizing bleed and being pumped without difficulty. The required grout strength shall be determined by the design engineer.

PART 3 EXECUTION

3.1 SITE VISIT

Site visits are necessary in order to be aware of conditions at the work site.

A. Pre Bid Site Visit: Prior to submitting a bid price for the rigid inclusion program, the RI Contractor shall visit the site during the project prebid meeting to identify readily visible conditions in order to account for them in the bid.

B. Existing Structures: Prior to initiating work, a condition survey of structures in the immediate vicinity of the work will be performed by either the Owner or General Contractor to determine that the conditions are safe to perform the specified work. A copy of the pre-cnstruction building survey will be provided to the RI contractor prior to the start of work and a copy will be maintained in the field throughout construction. The work shall be stopped and the engineer notified if any negative structural impacts are observed (settlement, increase in crack width, etc) to nearby structures.

3.2 SITE PREPARATION

The following shall be performed by the General Contractor in support of the RI Contractor*:*

A. Removal of all surface or subsurface topsoil, brush, organic material, and other unacceptable material in accordance with the requirements of the contract documents. Removal of any surface or subsurface obstructions to the RI work.

B. Site shall be graded to an agreed working elevation. A dry, level, and stable working platform shall be provided and maintained throughout the work. Platform stability should be evaluated and certified by the owner's geotechnical engineer and the general contractor, based on equipment information provided by the specialty contractor.

C. Provision of all-weather access and maintenance thereof for the RI Contractor's equipment and workforce, and for delivery of materials to the worksite.

D. Horizontal and vertical survey control and survey layout of building corners, grid lines, footing locations, embankment limits, utilities etc., for reference by the RI Contractor for layout and performance of the RI work.

3.3 RIGID INCLUSIONS

Rigid inclusions shall be constructed in accordance with the approved design and shop drawings, provided in the design submittal (section 1.6.B).

A. Procedures: Rigid inclusions shall be constructed at the locations shown on the RI layout drawing.

(General procedure, actual procedures will vary based upon the Specialty Contractor's Means and Methods) The RI tool shall be advanced to design depth or tool refusal. During grouting the RI tool shall be filled with a grout/concrete volume adequate to maintain a positive grout head for the RI withdrawal of the tool. Grout/concrete shall be placed fully to the final RI cutoff elevation.

The grout/concrete shall be supplied at a sufficient rate during tool withdrawal to ensure that a continuous element of the full specified cross-section is formed, free from debris. The depth of the tool and volume of grout shall be measured and recorded for each element. If the grout placement in any element cannot be completed as described above, then the element shall be re-penetrated before grout has hardened and grout placed to the final RI cutoff elevation or the RI shall be completely replaced.

B. Installation criteria: Installation criteria shall be as follows:

1. Location of RIs: The RIs shall be located within 6 inches of the planned horizontal location unless otherwise approved by the RI designer.

2. Obstructions: We note that subsurface obstructions, such as old building foundations or buried utilities) may be present in the subsurface. Obstructions encountered during advancement of the RI tool that will prevent installation to the design depth, or cause the RI tool to redirect from its design location during installation shall be removed.

   Obstruction include, but are not limited to: boulders, timbers, concrete, bricks, utility lines, etc. that prevent advancement of the RI tool to the required depth or cause the RI tool to redirect from the design location. Dense natural soil, natural rock or weathered rock shall not be considered obstructions. The RI design engineer shall be notified within 24 hours of any obstructions or unexpected early refusal to verify the revised location and/or depth are acceptable.

3. Depth of work: The RIs shall be constructed to the depth/elevation shown on the approved shop drawings or to the specified refusal criteria. RI installation rigs are equipped with instrumentation to measure, display and record the tool penetration rate versus depth.

4. Diameter of RIs: The RIs shall be constructed to the diameter shown on the project drawings or the approved shop drawings.

5. Refusal Criteria: Refusal of the RI tool is defined as a reduction in the penetration rate during installation, and shall be determined by competent field personnel and the RI designer. Specific refusal criteria will depend on project geology and equipment used, and will be established at the start of fieldwork.

6. Limits of work: As shown on the project drawings.

C. Completion: Prior to completion of the RI program the following shall be completed at each RI location.

1. Grout/concrete shall be cast to the final RI cutoff elevation unless otherwise specified. If necessary, to protect Rigid Inclusions from damage due to subsequent construction activities, elements shall be dipped out prior to initial set and backfilled with gravel or granular fill. Alternatively, a steel reinforcing member may be installed into the upper portion of the element to protect against damage.

D. Subsequent Construction: A Load Transfer Platform (LTP) shall be constructed over the RI heads to transfer the design loads to the elements. The LTP shall be constructed by the project Earthwork Contractor. The lateral extend and thickness of the LTP shall be included in the RI Contractor's design submittal.

1. The LTP shall be constructed of a dense graded granular material (specified in the Earthwork specification section) and may be reinforced with one or more layers of biaxial geogrid and/or geotextile as shown in the approved RI design and shop drawings.

   Construction of the LTP shall not commence until the compressive strength of the grout has reached a value provided by the RI design engineer. LTP material, lift thickness, and compaction shall conform to the approved RI design and shop

drawings. Testing requirements shall be equal to those required by the project geotechnical engineer of record. Materials shall conform to those specified in the approved RI design and shop drawings.

Construction of the LTP shall be installed in a manner as to avoid direct contact with cured rigid inclusions. The RI Contractor and RI Design Engineer shall be notified if any heavy machinery makes contact with a cured RI during LTP construction or excessive rutting is experienced adjacent to cured RIs. Replacement RIs may be required if RIs are damaged during LTP construction. Cost of construction of the replacement RI shall be borne by the owner or LTP installer.

2. The Owner's engineer shall monitor LTP construction and foundation construction. Compaction shall be performed and accomplished as specified in the contract drawings for structural fill or LTP construction. Footing/wall construction shall be performed in a timely manner so that no degradation of the bearing surface occurs. In the case of foundation construction, if foundation concrete cannot be placed on the same day that excavation takes place, then a minimum 3 inch thick mud mat shall be placed immediately following approval of the footing excavation and LTP construction.

3.4 QUALITY CONTROL

The details of the quality control program are as follows:

A. Oversight: All RI construction shall be performed under the inspection of the Contractor's field Quality Control Officer.

B. Monitoring and logging of all RI operations for all test areas and production work will be observed and documented by the Owner's Engineer. And include at a minimum Project name, number, contactor name, column location, column diameter, tip elevation, drilling ground surface elevation, total and incremental volume of grout placed, amount of water (if any) added to the ready mix grout truck at the site, column reinforcing (if applicable) any unusual occurrences during the column installation.

C. A test program to determine specification and design compliance shall be determined by the RI designer of record and the Owner's Engineer. This test program shall be implemented in accordance with the approved design submittal and shall include; grout/concrete sampling & testing, and at a minimum of one Compression Load Test. The load test shall be conducted consistent with applicable ASTM Standards and shall be conducted to a minimum of 125% of the design RI capacity.

D. A production quality control program shall be included in the work plan submittal describing sampling and testing procedures, frequency, and performance criteria to ensure that all construction materials are meeting the design requirements.

E. Layout of rigid inclusions is the responsibility of the RI contractor, based on sufficient specified layout or control points provided by the General Contractor.

3.5 ACCEPTANCE MEASUREMENTS, TESTING AND CRITERIA

The acceptance of the RI work shall be solely based on the following:

A. The performance verification load test program meets the requirements established by the RI designer of record.

B. All Rigid Inclusions are installed per the approved design and shop drawings.

C. All Rigid Inclusions are monitored in accordance with the quality control plan established by the RI designer of record.

A Rigid Inclusion may be rejected if it is installed in an incorrect location or the location exceeds the specified tolerance stated in Section 3.3B. If a Rigid Inclusion is rejected, the RI Specialty Contractor shall replace the RI. Replacement of the RI may be avoided if alternate remedial procedures are approved by the RI design engineer.

3.6 RESPONSIBILITIES OF OTHERS

The following restrictions apply to the performance of the work.

A. Permits and Regulations: The Owner or General Contractor shall be responsible for obtaining any State and municipal permits (if required).

B. Utilities and Obstructions: The General Contractor shall be responsible for the precise delineation of all above and below ground utilities and obstructions and shall accurately mark their layout at the site, as referenced in Section 3.02 C. Utilities which cannot be removed shall be exposed and made known to the RI Specialty Contractor prior to installation of adjacent RIs. When necessary, the General Contractor shall pot hole RI locations to verify no utilities are present prior to RI installation.

C. Other Restrictions: (ex. Environmental restrictions, work boundaries, hours for construction, etc.)

END OF SECTION

SECTION 031000

CONCRETE FORMING & ACCESSORIES

PART 1 - GENERAL

1.1 GENERAL REFERENCE

A. The work of this section is integral with the whole of the Contract Documents and is not intended to be outside that context.

1.2 DESCRIPTION OF WORK

A. Provide all labor, materials, equipment, services, and accessories necessary to furnish and install the Work of this Section, complete and functional, as indication in the Contract Documents and specified herein.

B. Provide formwork for cast-in-place concrete as indicated in the Drawings and specified herein.

C. Work includes formwork and shoring for cast-in-place concrete, and installation into formwork of items such as anchor bolts, setting plates, bearing plates, anchorages, inserts and other items to be embedded in concrete.

1.3 ALTERNATIVE (NOT USED)

1.4 RELATED WORK

A. Section 032000 – Concrete Reinforcing

B. Section 033000 – Cast-in-Place Concrete

C. Section 034100 – Structural Precast Concrete

1.5 SHOP DRAWINGS

A. Submit shop drawings for fabrication and erection of formwork for finished concrete surfaces. Show the general construction of forms including jointing, special formed joints for reveals, location and pattern of form tie placement, and other items, which affect the exposed concrete visually.

B. Architect’s review of shop drawings is for general architectural applications and features only.

1.6 SAMPLES (NOT USED)

1.7 PROJECT LITERATURE

A. Manufacturer’s Data:

1. Submit for Architect’s record manufacturer's data and installation instructions for materials including form coatings, manufactured form systems, ties and accessories.

1.8 MOCK UPS (NOT USED)

1.9 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be stored in the area designated by the General Contractor or Consultant. Containers shall have manufacturer's printed label.

B. Only approved materials or formwork that complies with PART 2 – PRODUCTS may be brought to designated storage area and used.

C. Store materials in single place designated by Owner and/or Consultant. Keep storage place neat and clean. Waste materials shall be removed from the site and storage area and placed in waste receptacle each night.

1.10 COORDINATION (NOT USED)

1.11 QUALITY ASSURANCE

A. Manufacturer's Qualifications (Not Used)

B. Subcontractor's Qualifications

1. Design of formwork & shoring for structural stability, strength and sufficiency to carry all applicable loads is the Contractor's responsibility.

C. Engineering

1. Reference Standards: Comply with the following standards, latest edition, except where more stringent requirements are shown or specified.

a. American Concrete Institute (ACI), ACI 347: Recommended Practice for Concrete Formwork.

b. American Concrete Institute (ACI): ACI 117, Standard Specifications for tolerances for Concrete Construction and Materials.

c. American Concrete Institute (ACI); ACI 301, Specifications for Structural Concrete.

d. Natinal Institute of Standards and Technology: Voluntary Product Standard PS-1.

2. Allowable Tolerances

a. Construction formwork to provide completed cast in place concrete structures complying with the tolerances specified in ACI 117, and as recommended by ACI 347 and ACI 301.

b. For concrete that is to be exposed and in view of the public including public or private streets, alley right of ways and including the interior of the garage area, formwork tolerances are to be Class B.

c. For concrete that is to be covered by architectural precast concrete and/or masonry, and structural panels that will be hidden from public view, formwork tolerances are to be Class C.

d. Before concrete placement check the lines and levels of erected formwork. Make corrections and adjustments to ensure proper size and locations of concrete members and stability of forming systems.

e. During concrete placement check formwork and related supports to ensure that forms are not displaced and that completed Work will be within specified tolerances.

f. Make provisions to compensate for shrinkage and post-tensioning process in order to maintain formwork tolerances.

3. Design of Formwork

a. Formwork and formwork systems shall be designed by a Professional Engineer employed by the Contractor. The Professional Engineer shall be registered in the state of Massachusetts. The Contractor shall submit written certification indicating conformance with this requirement.

b. Design, erect, support, brace and maintain formwork in accordance with ACI 301 and following recommendations of ACI 347, as modified herein. Forms shall be capable of safely supporting vertical and lateral loads that might be applied, until such loads can be supported by the concrete structure. Carry vertical and lateral loads to ground by formwork system and in-place construction that has attained adequate strength for that purpose.

c. Support form facing materials by structural members spaced sufficiently close to prevent deflection. Fit forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities and within allowable tolerances.

d. Design formwork to be readily removable without impact, shock or damage to cast in place concrete surfaces and adjacent materials.

e. Use shores and struts with positive means of adjustment capable of taking up formwork settlement during concrete placing operations, using wedges or jacks or a combination thereof. Use trussed supports when adequate foundations for shores and struts cannot be secured.

f. Formwork for Grade Beams and Footings: Side forms are required for all footings and grade beams.

1.12 WARRANTIES

A. Attention is directed to provisions of the CONDITIONS OF CONTRACT and applicable parts of Division 1 regarding guaranties and warranties.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS (NOT USED)

2.2 MATERIALS

A. Forms of Exposed Finish Concrete

1. Unless otherwise shown or specified, construct formwork for exposed concrete surfaces with plywood, metal, metal framed plywood faced or other panel type materials acceptable to Architect, to provide continuous, straight, smooth as cast surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings. Provide form material with sufficient thickness to withstand pressure of newly placed concrete without bow or deflection.

2. Plywood: Use overlaid plywood complying with PS 1, B B High Density Concrete Form Overlay, Class I.

B. Forms for Concrete Not Exposed

1. Form concrete surfaces, which will not be exposed in the finished structure with plywood, lumber, metal, or other acceptable material. Use lumber that is dressed on at least 2 edges and 1 side for tight fit.

C. Form Ties

1. Use factory fabricated, adjustable length, removable or snapoff metal or fiber reinforced plastic form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal.

2. Unless otherwise shown, use ties so that portion remaining within concrete after removal of exterior parts is at least 1 inch from the outer concrete surface. Unless otherwise shown, use form ties, which will not leave a hole larger than 1-inch diameter in the concrete surface.

3. For exposed finish concrete, use plastic cones and coil ties. All cone holes shall be plugged with plastic plugs set in a bed of sealant as approved by the Architect.

D. Nails and similar forming accessories, if to be left cast in concrete, shall be stainless steel.

E. Reglets: Fabricate of galvanized sheet steel not thinner than 26 gage. Opening at the face of reglet shall be temporarily covered or filled with removable material to prevent intrusion of concrete or debris.

F. Dovetail Anchor Slots: Fabricate of galvanized sheet steel not thinner than 22 gage. Opening at the slot exterior shall be temporarily covered or filled with removable material to prevent intrusion of concrete or debris.

G. Form Coating

1. Use commercial formulation form coating compounds with a maximum VOC of 350 grams per liter that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.

2. Provide a release agent equal to Nox Crete "Form Coating".

H. Metal Inserts

1. Use galvanized metal insets for anchorage of materials or equipment to concrete construction as required for the Work.
2. Use galvanized threaded inserts for thin slabs, furnished complete with full depth bolts; 3/4-inch bolt size, unless otherwise shown. Provide inserts manufactured by Dayton/Richmond Concrete Accessories or approved equal.

2.3 MIXES (NOT USED)

2.4 FABRICATION (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION AND INSPECTION

A. Examine the conditions under which concrete formwork is to be erected. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 WORKMANSHIP, PERFORMANCE (NOT USED)

3.3 INSTALLATION / APPLICATION / ERECTION

A. Form Construction

1. Construct forms to be the exact sizes, shapes, lines and dimensions shown, and as required to obtain accurate alignment, location, grades, levels, and plumb Work in finish structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustifications, reglets, chamfers, blocking screeds, bulkheads, anchorages and inserts, and other features required. Use selected materials to obtain required finishes.

2. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Use crush plates or wrecking plates where stripping may damage cast concrete surfaces. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and assure ease of removal.

3. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Brace temporary closures and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms in as inconspicuous location as possible; consistent with project requirements.

4. Construct formwork sufficiently tight to prevent leakage of cement paste during concrete placement. Solidly butt joints and provide backup material at joints as required to prevent leakage and fins.

B. Falsework

1. Erect falsework and support, brace and maintain it to safely support vertical, lateral and asymmetrical loads applied until such loads can be supported by in place concrete structures. Construct falsework so that adjustments can be made for take up and settlement.

2. Use wedges, jacks or camber strips to facilitate vertical adjustments. Carefully inspect falsework and formwork during and after concrete placement operations to determine abnormal deflection or signs of failure; make necessary adjustments to produce Work of required dimensions.

C. Forms of Exposed Concrete

1. Drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes. Do not splinter forms by driving ties through improperly prepared holes.

2. Do not use metal cover plates for patching holes or defects in forms.

3. Provide chamfered corners at intersecting planes, without visible edges or offsets. Back joints with extra studs or girts to maintain true, intersections.

4. Use extra studs, walers and bracing to prevent bowing of forms between studs and to avoid bowed appearance in concrete.

5. Place ties and spreaders symmetrically in plumb tiers and level rows.

6. Place pouring strips in the forms wherever horizontal construction joints are made.

7. Assemble forms so they may be readily removed without damage to exposed concrete surfaces.

8. Form molding shapes, recesses and projections with smooth finish materials, and install in forms with sealed joints to prevent displacement.

D. Corner Treatment

1. Form exposed corners to produce smooth, solid, unbroken lines, except as otherwise shown.

2. Form chamfers with 3/4 inch x 3/4-inch strips unless otherwise noted. Extend terminal edges to required limit and miter chamfer strips at changes in direction.

3. Unexposed corners may be formed either square or chamfered.

E. Edge Forms and Screed Strips for Slabs

1. Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finished slab surface. Provide and secure units to support types of screeds required.

F. Provision for Other Trades

1. Provide openings in concrete formwork to accommodate Work of others. Accurately place and securely support items to be built into forms.

G. Cleaning and Tightening

1. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is to be placed. Retighten forms immediately after concrete placement as required to eliminate mortar leaks.

H. Form Coatings

1. Prior to each concrete pour, treat form surfaces with a suitable release agent. Do not allow excess material to accumulate in the forms or to come into contact with surfaces which will be bonded to fresh concrete. Do not use release agents that stain or discolor concrete surfaces at areas exposed to view.

I. Installation of Embedded Items

1. General: Set and build into the Work anchorage devices and other embedded items required for other Work that is attached to, or supported by, cast in place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of the items to be attached thereto.

J. Removal of Forms

1. Formwork not supporting concrete, such as sides of beams, walls, columns, and similar parts of the Work, may be removed after cumulatively curing at not less than 50 degrees F. for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operation, and provided that curing and protection operations are maintained.

2. Formwork supporting weight of concrete, such as beam soffits, joists, slabs and other structural elements shall not be removed until concrete has attained its 28 day compressive design strength or as follows.

3. Form supports of non prestressed members may be removed when concrete has attained 75 percent of design compressive strength provided reshores are installed per Section 3.3.

3.4 FIELD QUALITY CONTROL (NOT USED)

3.5 CLEANING AND PROTECTION

A. Reuse of Forms

1. Clean and repair surfaces of forms to be re used in the Work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. Apply new form coating compound material to concrete contact surfaces as specified for new formwork.

2. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and latience, and tighten forms to close all joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces, except as acceptable to the Architect.

3.6 EXTRA STOCK / SPARE PARTS (NOT USED)

3.7 SCHEDULES (NOT USED)

END OF SECTION

SECTION 032000

CONCRETE REINFORCING

PART 1 - GENERAL

1.1 GENERAL REFERENCE

A. The work of this Section is integral with the whole of the Contract Documents and is not intended to be interpreted outside that context.

1.2 DESCRIPTION OF WORK

A. Provide all labor, materials, equipment, services and accessories necessary to furnish and install the work of this Section, complete and functional, as indication in the Contract Documents and specified herein.

B. The work includes furnishing, fabrication and placement of reinforcement for concrete, including bars, welded wire fabric, ties and supports.

C. Extent of concrete reinforcing work is shown on drawings and in schedules and includes the following:

1. Spread Footings
2. Retaining Walls
3. Cast-in-place concrete topping slabs around stairs and in stair towers
4. Slab-on-grade areas within stair towers
5. Slab-on-grade area at the Electrical Room and Storage room

1.3 ALTERNATIVES (NOT USED)

1.4 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 10 00 – Concrete Forming & Accessories

B. Section 03 30 00 – Cast-in-Place Concrete

C. Section 03 41 00 – Structural Precast Concrete

1.5 SHOP DRAWINGS

A. Submit to the Architect/Engineer for review shop drawings for fabrication, bending, and placement of concrete reinforcement. Comply with the ACI 315, and follow Standard Practice of ACI 315R and CRSI MSP. Show bar schedules, stirrup spacing, diagrams of bent bars, arrangements and assemblies, as required for the fabrication and placement of concrete reinforcement.

1.6 SAMPLES (NOT USED)

1.7 PRODUCT LITERATURE

A. Submit copies of manufacturer's specifications and installation instructions for all proprietary materials and reinforcement accessories.

B. Contractor shall furnish the copies of the manufacturer's records of chemical and physical properties of all heats of billet steel bars and, copies of affidavits for all material stating that the respective material furnished meets the requirements for the steel reinforcement specified. Manufacturer's records shall include certificates of mill analysis, tensile and bend tests.

1.8 MOCKUPS (NOT USED)

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver reinforcement to the project site bundled, tagged and marked. Use metal tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.

B. Store concrete reinforcement materials at the site to prevent damage and accumulation of dirt or excessive rust.

1.10 COORDINATION (NOT USED)

1.11 QUALITY ASSURANCE

A. Manufacturer's Qualifications

B. Subcontractor's Qualifications

C. Engineering

1. Codes and Standards: Comply with requirements of the following codes and standards, latest edition, unless more stringent provisions are indicated:

a. ACI 301, "Specifications for Structural Concrete".

b. ACI 318, "Building Code Requirements for Structural Concrete".

c. ACI 117, "Standard Specifications for Tolerances for Concrete Construction and Materials".

d. ACI 315, "Details and Detailing of Concrete Reinforcement".

e. ACI 315R, "Manual of Engineering and Placing Drawings for Reinforced Concrete Structures".

f. CRSI MSP, "Manual of Standard Practice".

g. ASTM A 185, "Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement."

h. ASTM A 615, "Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement."

i. ASTM A 706, “Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.”

j. ASTM A 775, “Standard Specification for Epoxy-Coated Steel Reinforcing Bars.”

k. ASTM A 884, “Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.”

l. D1.1 “Structural Welding Code – Steel”.

m. D1.4 “Structural Welding Code – Reinforcing Steel”.

2. Testing will be performed by an Independent Testing Laboratory paid for by the Owner.

3. Testing

a. Slump – Perform conventional slump test in accordance with A.S.T.M. C143 prior to adding the fibrous reinforcement.

b. Test Specimens – Fiber-reinforced concrete test specimens prepared for quality control/material acceptance shall be vibrated externally as opposed to internal rodding per the recommendations of ACI 544.

1.12 WARRANTIES

A. Attention is directed to provisions of the CONDITIONS OF CONTRACT and applicable parts of Division 1 regarding guaranties and warranties.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS (NOT USED)

2.2 MATERIALS

A. Concrete Reinforcing materials shall comply with the following requirements and standards, unless more stringent provisions are indicated:

1. Reinforcing Bars: ASTM A615, deformed billet-steel bars, yield strength as noted on the Drawings.

B. Welded Wire Fabric: ASTM A185.

1. Furnish in flat sheets, roll stock not acceptable.

2. Furnish epoxy coated wire mesh in pour strips over precast concrete members.

C. Fibrous Movement:

1. Chemical: Fibrous reinforcement shall be chemically and alkali inert, virgin, polypropylene.

2. Air-Entraining Admixture: ASTM C260.

3. Length: The fibrous bundle length shall be a minimum of 0.75”

4. Length: The fibrous bundle length shall be a minimum of 0.75”

5. Tensile Strength: 70,000 p.s.i. minimum.

D. Epoxy Coated: ASTM A775. Fusion bonded coating, apply after fabrication and bending. Film thickness of coating after curing to be 7 to 12 mils, when measured in accordance with Method G12. Provide epoxy coated reinforcing as indicated on the drawings and as defined below:

1. All reinforcement except welded wire fabric, in the upper 3” of the following concrete areas: elevated structural slab, rebar reinforced slab-on-grade, curbs or topping slabs, including but not limited to slab and beam/girder top bars, beam/girder stirrups and support steel for all epoxy coated reinforcement.

2. All parapet wall reinforcement, all “crash” wall and upturned beam reinforcement.

3. Retaining and foundation wall reinforcement adjacent to a face subject to “splash-zone” of de-icing chemicals.

4. All pour strip reinforcement, except as specified to be stainless steel in Section 03 41 00 “Structural Precast Concrete”.

5. All tie wire for epoxy coated rebar assemblies shall be epoxy or plastic coated. Wires shall be 16 gauge or heavier.

E. Supports for reinforcement. Bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcement in place.

1. Use wire bar type supports complying with CRSI recommendations, unless otherwise indicated. Do not use wood, brick and other unacceptable materials.

2. For slabs on grade, use supports with sand plates or horizontal runners where base material will not support chair legs.

3. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with plastic tip protected legs.

   a. Chairs and metal accessories supporting epoxy coated rebar shall also be epoxy coated.

4. Over waterproof membranes, use concrete chairs to prevent penetration of the membrane.

5. Provide accessories and supports for welded wire fabric and reinforcement in slabs as required to maintain concrete cover and position as shown on the drawings.

F. Weldable Reinforcing Bars: ASTM A706, Grade 60.

1. Tie Wire: All tie wires for noon-epoxy coated assemblies shall be 16 gauge or heavier, black annealed, unless noted otherwise.

2.3 MIXES (NOT USED)

2.4 FABRICATION (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION AND INSPECTION

A. Inspection of Reinforcement

1. Completed installation of concrete reinforcement shall be reviewed and approved by the Inspector prior to depositing concrete.

3.2 WORKMANSHIP, PERFORMANCE (NOT USED)

3.3 INSTALLATION / APPLICATION / ERECTION

A. Installation of Reinforcing

1. Comply with the specified codes and standards, and Concrete Reinforcing Steel Institute recommended practice for "Placing Reinforcing Bars" for details and methods of reinforcement placement and supports, and as herein specified.

2. Clean reinforcement to remove loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.

3. Repair the damaged bar coating with a procedure acceptable to the Architect/Engineer and in accordance with the coating manufacturer's instructions, to the satisfaction of the Independent Testing Laboratory prior to the reinforcement placement into forms. See Part 3, Paragraph B of this section for epoxy coated rebar handling.

4. Position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.

5. Place reinforcement to obtain the minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports together with 16 gauge wire to hold reinforcement accurately in position during concrete placement operations. Set wire ties so that twisted ends are directed away from exposed concrete surfaces.

6. Install welded wire fabric in as long lengths as practicable lap adjoining pieces at least one full mesh and lace splices with 16-gauge wire. Do not make end laps midway between supporting beams, or directly over beams of continuous structures. Offset end laps in adjacent widths to prevent continuous laps.

7. Provide sufficient numbers of supports and of strength to carry reinforcement. Do not place reinforcing bars more than 2 inches beyond the last leg of any continuous bar support. Do not use supports as bases for runways for concrete conveying equipment and similar construction loads.

8. Install reinforcement to tolerances given in ACI 117 2.2.

9. Splices:

a. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tightly wire tying. Comply with requirements of ACI 318 for minimum lap of spliced bars. Unless otherwise indicated on the design drawings, comply with requirements of ACI 318 Chapter 12 for Class B tension lap splices for reinforcement with proper adjustment for location, clear cover and spacing.

b. Do not make splices at points of maximum stress if possible.

c. Stagger splices in horizontal wall reinforcement and separate at least five (5) ft. longitudinally in alternate bars of opposite tiers.

d. Stubs and dowels required to receive and engage subsequent work shall extend a sufficient length to develop the strength of the bar. Place dowel and stub bars in the forms and secure against displacement during the placing of concrete. Where stub steel and dowels extend through construction joints in structural members, they shall be adequately protected from corrosion and thoroughly cleaned of adhering particles of concrete, before continuing the placing of any subsequent concrete.

10. Welding of Reinforcement: Welding of reinforcing bars is not permitted except where specifically indicated or approved by the Architect. Where permitted, only weldable reinforcement meeting ASTM A706 shall be permitted. Weld in accordance with AWS D1.4. Notify the Architect and the Testing Laboratory at least one day prior to welding operation.

11. Field Bending of Reinforcement: Reinforcement partially embedded in concrete shall not be field bent except as shown on the drawings or specifically permitted by the Architect.

B. Placing Epoxy-Coated Bars

C. Addition of Fibrous Reinforcement

1. Volume: Where identified on the Plans, Specifications, and at all stair landings or as allowed by the Engineer, fibrous reinforcement shall be used at the rate of 1.6 pounds (minimum) per cubic yard of concrete.

2. Addition and Mixing - The fibrous reinforcement shall be added directly into the concrete either at the batch plant or at the job site. If added at the batch plant with the aggregates, typically no additional site mixing time is required. If a superplasticizer is used, the fibrous reinforcement shall be added first. If the mixing drum contains less than 50% of capacity (i.e., 4 cubic yards in a 10 cubic yard capacity drum), back the concrete up to the top of discharge and empty the fibrous reinforcement directly on top of the concrete before mixing.

3. Placement - Fibrous reinforced concrete shall be moved and placed per standard A.C.I. recommendations. Tined rakes are prohibited as a means of moving the fibrous concrete. If pumping or shooting fibrous concrete, elevate ready mix discharge chute approximately 12" (or higher) above the pump grate or screen to improve the fibrous concrete flow into the pump.

3.4 FIELD QUALTIY CONTROL (NOT USED)

3.5 CLEANING AND PROTECTION (NOT USED)

3.6 EXTRA STOCK/SPARE PARTS (NOT USED)

3.7 SCHEDULES (NOT USED)

END OF SECTION

SECTION 033000

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 GENERAL REFERENCE

A. The work of this Section is integral with the whole of the Contract Documents and is not intended to be interpreted outside that context.

1.2 DESCRIPTION OF WORK

A. Provide all labor, materials, equipment, services and accessories necessary to furnish and install the work of this Section, complete and functional, as indicated in the Contract Documents and as specified herein.

B. The principal work of this Section includes, but may not be limited to, the following:

1. Spread Footings
2. Retaining Walls
3. Cast-in-place concrete topping slabs around stairs and in stair towers
4. Slab-on-grade areas within stair tower
5. Slab-on-grade area at grade level
6. Sidewalks

C. Work includes providing cast-in-place concrete consisting of Portland cement, fine and coarse aggregate, water, and selected admixtures; combined, mixed, transported, placed, finished and cured as herein specified.

D. The work includes constructing expansion joints, contraction joints and water stops for cast-in-place concrete.

1.3 ALTERNATES (NOT USED)

1.4 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 10 00 – Concrete Forming & Accessories

B. Section 03 20 00 – Concrete Reinforcing

C. Section 03 41 00 – Structural Precast Concrete

D. Section 04 20 00 – Unit Masonry

E. Section 05 70 00 – Decorative Metals

F. Section 07 50 00 – Single Ply Adhered Roofing

G. Section 07 95 00 – Expansion Control

H. Section 09 91 00 – Painting

1.5 SHOP DRAWINGS (NOT USED)

1.6 SAMPLES (NOT USED)

A. Submit samples of concrete materials if requested by the Architect, including names, sources, and descriptions.

1.7 PRODUCT LITERATURE

A. Manufacturer's Data:

1. Submit manufacturer’s data for proprietary items and other information described herein and as specified in the Project documents.

B. Mix Designs:

1. Submit substantiating data for each concrete mix design contemplated for use to the Architect not less than four (4) weeks prior to the pre-concrete conference; Part 2, Section 2.2, Paragraph K and J. Data for each mix shall, as a minimum, include the following:

a. Mix identification designation (unique for each mix submitted).

b. Statement of intended use for mix.

c. Method used to establish a proposed design for each mix (ACI 301).

d. Mix proportions, including all admixtures used.

e. Manufacturer's data and material certifications signed by the material manufacturer and the Contractor certifying conformance of all materials, including admixtures, with specified requirements.

f. Wet and dry unit weight.

g. Entrained air content. Determine of freshly mixed concrete by pressure method, ASTM C231, or volumetric method, ASTM C173.

h. Design slump, per ASTM C143.

i. When statistical data for a proposed mix is available, and has been compiled within the 12 months time prior to the commencement of this project, and is spanning a period of not less than 60 calendar days, submit required average strength qualification data per ACI 301. Submit separate qualification data for each production facility, which will supply concrete to the project.

j. Average strength qualification data (trial mix data or field test data per ACI 301. When field test data for at least 10 consecutive strength tests for one mixture is used to qualify average strength with the same materials and data acquisition encompassing a period of not less than 60 days, or trial mixtures are used to establish a design mixture proportions, submit separate qualification data for each

production facility, which will supply concrete to the project. Trial mixtures evaluation shall be in strict accordance with ACI 301.

k. Field test data submitted for qualification of average strength under ACI 301 shall include copies of the Concrete Testing Agency's reports from which the data was compiled.

l. Tests of proposed mixes for water soluble chloride ion content for all above grade structural concrete and for slab-on-grade reinforced concrete in accordance with ASTM C1218.

m. Submit one copy of a representative concrete batch trip ticket containing information as specified herein.

n. Separate design mixes are required for each strength and class of concrete, each change in type and/or quantity of mix materials including admixtures, each change in slump limits, and each change in entrained air content.

C. Mix designs submitted without the required information outlined above will be rejected. Concrete shall not be placed without an approved mix design.

D. Product Data:

1. Submit product data with application and installation instructions for proprietary materials and items including admixtures, patching compounds, epoxies, grouts, and others as required by the Architect.

2. Submit curing compound product data and verification of its compatibility with other finish materials and surface treatments required.

E. Submit to the Architect for record a written program outlining procedures/measures to protect and monitor freshly mixed and/or placed concrete in cold and hot weather and procedures for protection of the freshly placed concrete against rain. The program shall be submitted no later than two weeks prior to the pre-concrete conference, and shall be discussed therein.

1.8 MOCK UPS

A. Cast concrete supported slab mockups to demonstrate typical joints, surface finish, texture, tolerance, and standard of workmanship including for the following areas

1. 5'x10' sidewalk mock-up:

2. 5'x5' area of smooth rubbed wall finish within 4 hours of form removal, if necessary re-work until finish smooth, uniform and free of fins, formwork marks and imperfections as directed prior to finishing remainder of wall area.

3. Provide 4'x4' mock-up of broom finish required at cast-in-place surfaces defined in Section 1.2, Paragraph B, 3, 4 and 5. Only one mock-up required for all areas.

4. Do not proceed with cast-in-place concrete work until mock-up for corresponding is approved.

5. Mockups, if accepted may become part of final work.

1.9 DELIVERY, STORAGE AND HANDLING

A. Delivery of Materials: Deliver materials in manufacturer's unopened containers fully identified with manufacturer's name, trade name, type, class, grade, size, and color.

B. Storage of Materials: Store materials in unopened containers. Store off ground and under cover, protected from damage.

C. Concrete:

1. Hauling Time: Discharge all concrete transmitted in a truck mixer, agitator, or other transportation device not later than 1 1/2 hours, or 300 revolutions of the drum after the mixing water has been added, whichever is earliest.

2. Extra Water: Deliver concrete to the job in exact quantities required by the design mix. No water shall be added after batching of concrete.

1.10 COORDINATION (NOT USED)

1.11 QUALITY ASSURANCE

A. Codes and Standards: Comply with requirements of the following codes and standards, latest edition, unless more stringent provisions are indicated:

1. ACI 301, “Specification for Structural Concrete.”

2. ACI 117, “Standard Specifications for Tolerances for Concrete Construction and Materials.”

3. ACI 311.4R, “Guide for Concrete Inspection.”

4. ACI 318, “Building Code Requirements for Structural Concrete”.

5. ACI 304, “Guide for Measuring, Mixing, Transporting and Placing Concrete.”

6. ACI 305R, “Hot Weather Concreting.”

7. ACI 306.1, “Cold Weather Concreting.”

8. ASTM C 33, Standard Specifications for Concrete Aggregates.

9. ASTM C 94, Standard Specifications for Ready Mix Concrete.

10. ACI SP-66 ACI Detailing Manual.

11. ACI SP-15, ACI Field Reference Manual.

12. Concrete Reinforcing Steel Institute “Manual of Standard Practice”.

B. Record of Work: A record shall be kept by the General Contractor listing the time and date for all cast-in-place concrete placements for the structure. Such records shall be kept until the completion of the project and shall be available to the Architect for examination at any time including concrete batch trip tickets. Concrete batch trip tickets shall contain all information specified in ASTM C94, paragraph entitled "Batch Ticket Information" including:

1. Name of ready-mix batch plant,

2. Serial number of ticket,

3. Date,

4. Truck Number,

5. Name of Purchaser,

6. Specific Job name & location,

7. Specific class or designation of the concrete (ie; footings, retaining wall, side walk)

8. Amount of concrete in cubic yards

9. Time Loaded or first mixing of cement and aggregates

10. Water Added by receiver of concrete & his initials

11. Additional information for certification purposes including:

    a. Type & brand of cement

    b. Type, brand & amount of admixtures

    c. Total amount of water in the mix as batched (including water present in the aggregate before batching) and the amount of water required by the design mix proportions.

    d. All information necessary to calculate the total mixing water added by the producer including free water of the aggregates water, ice and water added by the truck operator.

    e. Maximum size of aggregate

    f. Total lbs of fibrous reinforcement added

    g. Weights of fine and coarse aggregates

C. The Contractor shall be responsible for designing the required concrete mixes such that mixing, placing and finishing operations are possible without compromising the performance of the finished product during service life.

1.12 WARRANTIES

A. Attention is directed to provisions of the CONDITIONS OF CONTRACT regarding guaranties and warranties.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Self-Expanding Strip Waterstops:

1. Volclay Waterstop-RX; Colloid Environmental Technologies Co.

2. Superstop; Progress Unlimited Inc.

3. Swell Stop – Green Streak.

B. Patching Mortar:

1. "SikaTop 121 Plus or122 Plus": Sika Chemical Corp.

2. "Verticoat or Verticoat Supreme": Euclid Chemical Co.

3. "EMACO R310 CI or R320 CI": Master Builders.

4. "HB2 Repair Mortar": ChemRex, a Div. of Degussa, Inc.

C. Liquid Membrane-Forming Curing Compound or Dissipating Resin Compound:

1. "Kurez DR" - Euclid Chemical Co.

2. "L & M Cure R" - L & M Construction Chemicals, Inc.

3. "Clear 1100" - W. R. Meadows

4. "EZ Strip Cure" - ChemMasters

5. Approved Equivalent

D. Evaporation Retarder:

1. "Eucobar" - Euclid Chemical Co.

2. "E-Con"- L & M Construction Chemicals, Inc.

3. "Confilm" - Master Builders, Inc.

E. Non Shrink Non Metallic Grout:

1. Euco NS: The Euclid Chemical Co.

2. Masterflow 713: Master Builders

3. Or approved equal

F. High Flow Grout:

1. Euco Hi-Flow Grout: The Euclid Chemical Co.

2. Masterflow 928: Master Builders

3. Sikadur 42 Grout-PAK PT: Sika Corporation

G. Air Entraining Admixtures:

1. "Air-Mix": Euclid Chemical Co.

2. "Sika Aer": Sika Corporation

3. "MB-VR or MB- Ae": Master Builders

4. "Darex AEA" or "Daravair": W.R. Grace

H. Water Reducing Admixture:

1. WRDA Hycol": W. R. Grace

2. "Eucon WR-75 or WR-89": Euclid Chemical Co.

3. "Pozzolith Normal": Master Builders

4. "Plastocrete 160": Sika Chemical Corp.

I. High-Range Water-Reducing Admixture (Superplasticizer):

1. "Sikament 300": Sika Chemical Corporation

2. "Eucon 37': Euclid Chemical Co.

3. "Daracem-100": W. R. Grace

4. "Rheobuild 1000": Master Builders

J. Water Reducing, Non-Corrosive Accelerating Admixture:

1. "Accelguard 2 R. Grace

2. “Sika Rapid-1”: Sika Corporation

K. Water-Reducing and Retarding Admixture:

1. "Pozzolith Retarder": Master Builders

2. "Eucon Retarder 75": Euclid Chemical Co.

3. "Daratard": W. R. Grace

4. "Plastiment": Sika Chemical Co.

L. Corrosion Inhibiting Concrete Admixture:

1. "Catexol 1000 CN-CI": Axim Concrete Technologies

2. "Eucon CIA": Euclid Chemical Co.

3. "DCI or DCI-S": W. R. Grace

4. "Rheocrete CNI”: Master Builders, Inc.

No substitutions allowed.

M. Structural Fiber for areas of concrete structure specifically designated:

1. "Strux 90/40”: Grace Construction Products

2. "Tuf-Strand SF": Euclid Chemical Co.

3. “Sika Fiber”: Sika Corporation

2.2 MATERIALS

A. Cementitious Materials:

1. General: Provide materials of the same brand or source throughout the project unless otherwise specified.

2. Portland Cement: ASTM C150, Type I. High-Early Strength Type III cement may be used in lieu of Type I at Contractor's option, provided a written notification is submitted to the Architect prior to use and the concrete ready mix supplier certifies in writing the compatibility of the proposed cement with other constituents of the mix. Type III cement shall not be used for hot weather concreting.

3. Fly Ash: ASTM C618, Class C or F.

4. Ground Granulated Blast Furnace Slag (GGBFS): ASTM C989, Grade 100 or 120.

B. Aggregates: ASTM C33, and as herein specified.

1. General: Provide aggregates from the same source throughout the project unless otherwise specified.

2. Fine aggregate: clean, sharp, natural sand free from loam, clay lumps or other deleterious substances.

3. Coarse Aggregate: Clean, uncoated, processed aggregate containing no clay lumps, mud, loam, or foreign matter, as follows:

a. Crushed stone, processed from natural rock or stone.

b. Washed gravel, either natural or crushed. Use of pit or bank run gravel is not permitted.

c. Maximum Aggregate Size shall be per ACI 318. For P.T. slabs and beams, maximum aggregate size shall be 1”.

d. No chert or lignite allowed.

e. Water: Clean, fresh, drinkable.

C. Waterstops

1. Flexible Rubber Waterstops: CE CRD-C 513, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes, minimum web thickness 3/8 inch.

a. Profile: Ribbed with center bulb.

2. Flexible PVC Waterstops: CE CRD-C 572, for embedding in concrete to prevent passage of fluids through joints. Factory fabricate corners, intersections, and directional changes.

a. Profile: Ribbed with center bulb.

D. Self-Expanding Strip Waterstops: Manufactured rectangular or trapezoidal strip, for adhesive bonding to concrete.

E. Joint Materials

1. Joint Sealing Compound & Expansion Joint: See Division 7 Sections.

2. Joint-Filler Strips: See ASTM D1751, Asphalt-Saturated Cellulosic Fiber.

F. Moisture Barrier

1. Polyethylene sheet: minimum 6 mils thick complying with ASTM E154. Provide where shown on the Drawings.

G. Bonding and Repair Materials

1. Bonding Grout: After the existing concrete surface has been cleaned, it shall be uniformly saturated by pre-wetting for 2 hours, and free standing water shall be removed prior to placing the bonding grout before concrete repairs.

a. Bonding grout for concrete applied to existing concrete shall consist of equal parts by weight of Portland Cement and sand mixed in a portable mechanical mixer with sufficient water to form a stiff slurry. The consistency of this slurry shall be such that it can be applied with a stiff brush or broom to the old concrete in a thin, even coating that will not run or puddle in low spots.

b. Should the bonding grout dry before the concrete repairs, the Contractor will remove the dried grout and sandblast clean the grouted surface, before placing fresh bonding grout.

2. Patching Mortar: Provide free-flowing, polymer-modified cement-based repair mortar, suitable for thin applications. All proposed repairs and repair applications shall be submitted and approved prior to application.

H. Concrete Curing Materials

1. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd. and complying with AASHTO M182, Class 3

2. Moisture Retaining Cover: Provide one of the following, complying with ASTM C171:

a. Waterproof paper

b. Polyethylene film

c. White burlap polyethylene sheet

3. Liquid Membrane-Forming Curing Compound or Dissipating Resin Compound: ASTM C309, Type 1 Curing compound shall leave no surface residue and shall be compatible with paint and finish floor materials specified in other sections of this Specification. The dissipating resin compound film must chemically break down in a two to four week period. Provide data from an independent laboratory indicating a maximum moisture loss of 0.03 grams per sq. cm. in 72 hours when applied at a coverage rate of 300 ft2 per gallon. Manufacturer's certification and method of removal are required.

a. The contractor shall anticipate providing as a minimum concrete surface preparation by a power sweep or low pressure water blast (3,000 psi), as a normal part of the work.

4. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete. Evaporation retarder shall be used to retard rapid evaporation of bleeding water from exposed concrete under adverse curing conditions.

I. Grout Materials:

1. Non shrink non metallic grout shall be premixed and packaged silica aggregates, Portland cement, water reducing and shrinkage compensating agents. Grout shall conform to ASTM C1107, "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)." In addition, the grout manufacturer shall furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95% bearing under a 4' x 4' base plate.

2. High Flow Grout: Where high fluidity and/or increase placing time are required use high flow grout. Non-shrink, natural aggregate factory pre-mixed grout shall conform to ASTM C1107, "Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)." In addition, the grout manufacturer shall furnish test data from an independent laboratory indicating that the grout when placed at a fluid consistency shall achieve 95% bearing under an 18" x 36" base plate.

J. Proportioning and Design of Mixes

1. Design and Properties of Concrete:

a. Prepare a concrete design mix composed of Portland cement, water, fine and coarse aggregate, appropriate admixtures and cementitious materials as required to obtain the specified strength requirements and will produce concrete with equal finish quality, surface appearance and durability required.

b. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.

2. The concrete mixes proportioned on the basis of trial mixture shall meet the provisions of ACI 301.

3. Requirements for concrete mix unless otherwise shown on drawings.

a. Compressive Strength

1) 4,000 psi @ 28 days or as indicated on drawing for footings, foundation mats, sidewalks and pads.

2) 5,000 psi @ 28 days or as indicated on drawing for all other applications.

b. Slump = 3” maximum prior to addition of super plasticizer.

c. Water-cementitious ratio = 0.38 (Elevated Deck)
= 0.40 (Foundations, Slab-On-Grade, sidewalks and Walls)

d. Air Content = 4½ to 6½ %

e. Minimum Cement Content = 560 lb/cyd.

f. Admixtures as specified in the contract documents.

4. Prepare design mixes for each type and strength of concrete determined by either laboratory mix or field test data.

5. Cementitious Materials: For concrete exposed to deicers, limit percentage by weight, of cementitious materials other than Portland cement according to ACI 301 requirements.

6. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than Portland cement in concrete as follows:

a. Fly Ash: 25 Percent

b. Fly Ash plus Pozzolan: 25 Percent

c. Ground Granulated Blast Furnace Slag (GEBFS): 25 Percent

d. Fly Ash or Pozzolan plus GGBFS: 35 Percent (Min. GGBFS = 15 Percent.)

7. Adjustment to Concrete Mixes: Mix design adjustments may be requested by the Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to the Owner and as accepted by the Architect. Laboratory test data for revised mix designs and strength results must be submitted to and accepted by the Architect before using in the work.

K. Pre-Concrete Conference

1. At least 10 days prior to start of the cast-in-place concrete construction, the contractor shall conduct a meeting with the Owner's representative, testing agent, resident engineer and Contractor's representatives to review the proposed mix designs and to discuss the required methods and procedures to achieve the required concrete quality. The contractor shall send a pre-concrete conference agenda to all attendees 5 days prior to the schedule date of the conference.

2. The contractor shall require responsible representatives or every party who is concerned with the concrete work to attend the conference, including but not limited to the following:

a. Contractor's superintendent

b. Laboratory responsible for the concrete design mix.

c. Laboratory responsible for field quality control.

d. Concrete subcontractor.

e. Ready-mix concrete producer

f. Admixture manufacturer(s)

g. Concrete pumping contractor

h. Concrete finishing Foreman

3. Minutes of the meeting shall be recorded, typed and printed by the contractor and distributed to all parties concerned within 5 days of the meeting. One copy of the minutes shall also be transmitted to the following for information purposes:

   a. Owner's representative

   b. Resident engineer

   c. Consultant engineer

   d. The minutes shall include a statement by the admixture manufacturer(s) indicating that the proposed mix design and placing techniques can produce the concrete quality required by these specifications.

2.3 MIXES

A. General: Admixtures certified by manufacturer to contain not more than 0.05 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride or other corrosive elements. Do not use admixtures which have not been incorporated and tested in the accepted design mixes, unless otherwise authorized in writing by the Architect/Engineer.

B. Prohibited Products: Calcium chloride or admixtures containing more than 0.05% chloride ions or thiocyanates are not permitted.

C. Air Entraining Admixtures: ASTM C260, certified by manufacturer to be compatible with other required admixtures.

D. Water Reducing Admixture: ASTM C494, Type A.

E. High-Range Water-Reducing Admixture (Superplasticizer): ASTM C494, Type F or Type G.

F. Water Reducing, Non-Corrosive Accelerating Admixture: The admixture shall conform to ASTM C494, Type C or E. The admixture manufacturer must have long-term non-corrosive test data from an independent testing laboratory (of at least a year's duration) using an acceptable accelerated corrosion test method such as that using electrical potential measures.

G. Water-Reducing and Retarding Admixture: ASTM C494, Type D.

H. Corrosion Inhibiting Concrete Admixture: ASTM C494, Type C, shall be used in elevated structure, columns, and rebar reinforced slab-on-grade, unless otherwise noted. Minimum dosage: 2.5 gal./cu. yd.

I. Structural Fiber for areas of concrete structure specifically designated: Monofilament polypropylene/polyethylene fibers, 1.5 to 2 inch in length with a minimum tensile strength of 70 ksi and the minimum Modulus of Elasticity of 600 ksi. The manufacturer shall demonstrate the attainment of average residual strength of not less than 140 psi per ASTM C1399 based on the proposed dosage. Minimum dosage shall not be less than 3 lbs/cu. yd.

J. Certification: Written certification of conformance to above requirements will be required from all admixture manufacturers prior to mix design review by the Architect.

K. Job Conditions

   1. Environmental Requirements:

a. Cold Weather Placement: When depositing concrete after the first frost or when the mean daily temperatures are below 40 degrees F., follow requirements of ACI 306.1 and recommendations of ACI 306R as modified herein.

1) Maintain concrete temperature at a minimum of 55 degrees F. for sections having a minimum dimension of less than 12", or 50 degrees F. for sections having a minimum dimension of 12" or greater, for not less than 72 hours after depositing.

2) Maintain temperature of concrete record during the required minimum protection period and as described in Section 014500, Quality Control, of these specifications.

3) The specified non-chloride accelerator or high-early strength Type III cement may be used when accepted by the Architect. Site-cured cylinders for verification of early strength and/or the adequacy of the Contractor's protective methods, may be required by the Architect.

b. Hot Weather Placement: When depositing concrete in hot weather, follow recommendations of ACI 305R as modified herein. The temperature of concrete at time of placement shall not exceed 90 degrees F. Protect to prevent rapid drying. Start finishing and curing as soon as possible. When the air temperature is expected to exceed 90 degrees F., the Contractor shall obtain acceptance from the Architect of the procedures to be used in protecting, depositing, finishing, and curing the concrete. The specified water reducing retarding admixture may be used upon acceptance of the Architect. The use of continuous wetting or fog sprays may be required by the Architect for 24 hours after depositing.

2.4 FABRICATION (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION AND INSPECTION

A. Pre placement Inspection:

1. Before placing concrete, inspect and complete the formwork installation, reinforcing steel, and securely install all required inserts, anchors, sleeves, conduits and other items specified under other sections or as shown on the Contract Drawings to be embedded or cast in.

a. The contractor shall provide reasonable opportunity for the Owner and his representative(s) to perform pre placement inspection of items noted above.

2. Where concrete is placed on the ground or subcourse, the foundation upon which concrete is placed shall be clean, damp, and free from frost, ice, and standing or running water. Prior to placing concrete, bottom of the foundation shall be compacted and approved by the Geotechnical Engineer.

3. Soil at bottom of foundation systems are subject to testing for soil bearing value by the testing laboratory, as directed by the Geotechnical Engineer. Place concrete immediately after approval of foundation excavations.

4. Thoroughly wet wood forms immediately before placing concrete, as required where form coatings are not used.

5. Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.

3.2 WORKMANSHIP, PERFORMANCE (NOT USED)

3.3 INSTALLATION/APPLICATION/ERECTION

A. Concrete Placement

1. General: Place concrete in compliance with the practices and recommendations of ACI 304R and ACI 304.2R and as herein specified.

   a. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete, which is hardened sufficiently to cause the formation of seams or planes of weakness within the section. If a section cannot be place continuously, provide construction joints as herein specified. Perform concrete placing at such a rate that concrete which is being integrated with fresh concrete is still plastic. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing. Do not subject concrete to any procedure which will cause segregation.

   b. Do not use concrete which becomes non plastic and unworkable, or does not meet the required quality control limits, or which has been contaminated by foreign materials. Do not use re-tempered concrete. Remove rejected concrete from the project site and dispose of it in an acceptable location.

2. Placement Schedule: Place concrete in conformance with the approved placement schedule to ensure an even distribution of loads throughout the entire structure.

3. Concrete Conveying: Handle concrete from the point of delivery and transfer to the concrete conveying equipment and to the locations of final deposit as rapidly as practicable by methods which will prevent segregation and loss of concrete mix materials.

   a. Provide mechanical equipment for conveying concrete to ensure a continuous flow of concrete at the delivery end. Keep interior surfaces of conveying equipment, including chutes, free of hardened concrete, debris, water, snow, ice and other deleterious materials.

4. Placing Concrete Into Forms:

   a. Deposit concrete in forms in horizontal layers not deeper than 12 inches unless additional thickness is permitted by the Architect, and in a manner to avoid inclined construction joints.

   b. Free fall shall not exceed ten (10) feet for concrete containing a high range water reducing admixture (super plasticizer) or six (6) feet for other concrete. Use chutes or trunks of variable lengths to prevent segregation of concrete.

   c. Remove temporary spreaders in forms when concrete placing has reached the elevation of such spreaders.

   d. Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by handspading, rodding or tamping. Use equipment and

procedures for consolidation of concrete in accordance with the recommended practices of ACI 309R, to suite the type concrete and project conditions. Vibration of forms and reinforcing will not be permitted.

e. Use appropriate size vibrators for the elements, in which concrete is being consolidated.

f. Do not use vibrators to transport concrete inside of forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than the visible effectiveness of the machine. Place vibrators to rapidly penetrate the layer of concrete and at least 6 inches into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set.

g. In order to allow for shrinkage or settlement, at least 4 hours shall elapse after placing concrete in walls, columns or beams before depositing concrete in girders, beams or slabs supported thereon, unless otherwise specified or shown on the plans.

5. Placing Concrete Slabs:

a. Deposit and consolidate concrete slabs in a continuous operation, within the limits of construction joints, until the placing of a panel or section is completed.

b. Maintain reinforcing steel in the proper position continuously during concrete placement operations.

c. Consolidate concrete during placing operations using mechanical vibrating equipment, so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

d. Floor slabs shall be poured up hill at ramps.

e. Bring slab surfaces to the correct level with a straight edge over screed rails and strike off space screed rails at 10 to 12 feet on center, or as required based on screed stiffness, to produce a concrete slab of uniform thickness. Use bull floats, highway straight edges or darbies to smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations.

6. Bonding:

a. Prepare for bonding of fresh concrete to new concrete that has set but is not fully cured by using neat cement grout.

1) Roughen surfaces of set concrete at all joints, except where bonding is obtained by use of a concrete bonding agent, and clean surfaces of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner to expose bonded aggregate uniformly.

2) At joints between footings and walls, and between walls and slabs they support, and elsewhere unless otherwise specified herein, dampen, but do not saturate the roughened and cleaned surface of set concrete immediately before placing fresh concrete.

3) At joints in exposed work: At vertical joints in walls, at joints in supported slabs and other structural members; dampen the roughened and cleaned

surface of set concrete and apply a liberal coating of the neat cement grout consisting of equal parts Portland cement and fine aggregate by weight and sufficient water to achieve the consistency of stiff grout or thick paint. Apply with a stiff broom, brush, or spray to a minimum thickness of 1/16 inch. Deposit fresh concrete before cement grout has attained its initial set.

7. Cold Weather Placing:

a. Protect all concrete work from physical damage or reduced strength, which could be caused by frost, freezing actions, or low temperatures, in compliance with the requirements of ACI 306.1, recommendations of ACI 306R and as herein specified.

b. When the air temperature has fallen to or is expected to fall below 40 degrees F., uniformly heat all water and aggregates before mixing as required to obtain a concrete mixture temperature of not less than 50 degree F. and not more than 80 degree F. at point of placement.

c. Provide adequate means to maintain a cure temperature in the area where concrete is being placed at either 70 degrees F. for 3 days or 50 degrees F. for 5 days after placing. Provide temporary housings or coverings including tarpaulins or plastic film. Keep protections in place and intact at least 24 hours after artificial heat is discontinued. Avoid rapid dry out of concrete due to overheating, and avoid thermal shock due to sudden cooling or heating.

d. Do not use frozen materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials. Ascertain that forms, reinforcing steel, and adjacent concrete surfaces are entirely free of frost, snow and ice before placing concrete.

e. Only the specified non-corrosive non-chloride accelerator shall be used. Calcium chloride, thiocyanates or admixtures containing more than 0.05% chloride ions are not permitted.

f. Use set control admixtures when required and accepted in mix designs.

8. Hot Weather Placing:

a. When hot weather conditions exist that would seriously impair the quality and strength of concrete, place and protect concrete in compliance with ACI 305R and as herein specified.

b. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees F. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature provided the water equivalent of the ice is calculated to the total amount of mixing water.

c. Wet forms thoroughly before placing concrete.

d. Retarding admixture may be used with approval of Architect/Engineer.

B. Joints

1. Construction Joints:

a. Locate and install construction joints, which are not shown on the drawings, so as not to impair strength and appearance of the structure, as acceptable to the Architect.

b. Provide keyways at least 1 1/2 inches deep in all construction joints in walls, slabs on grade, and between walls and footings.

c. Place construction joints perpendicular to the main reinforcement. Continue all reinforcement across construction joints.

d. Construction joints in walls and beams shall not be located within 10 feet of corners.

e. Tool or saw cut construction joints in supported slabs approximately 3/8 inch wide by 3/4 inch deep.

2. Waterstops:

a. Provide waterstops in construction joints and expansion joints as shown on the drawings. Install waterstops to form a continuous diaphragm in each joint. Make provisions to support and protect waterstops during the progress of the work.

3. Isolation Joints in Slabs on Ground:

a. Provide isolation joints in slabs on ground at all points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, and elsewhere as indicated.

4. Control Joints in Slabs on Ground:

a. Provide control joints in slabs on ground to form panels or patters as shown. If not shown, provide joints to form panels approximately fifteen (15) feet by fifteen (15) feet in size. Ratio of long side to short side shall not exceed 1.25.

b. Tool or Soff-cut with V-blade within one to four hours after the finishing process and before final set without dislodging aggregates. The V-joint shall be 1 (one) inch deep and ¼ inch wide.

5. Control Joints in Walls:

a. Control joint spacing shall not be any greater than:

1) 3 times the wall height for walls 8 feet and lower

2) 2 times the wall height for walls greater than 8 feet and lower than 12 feet

3) Equal to the wall height for walls 12 feet and taller

b. The total depth of the control joint shall be at least a ¼ of the wall thickness

6. Control Joints in Topping Slabs:

a. Provide control joints in the topping slabs to form panels or patterns as shown on the drawings.

b. Tool or Soff-cut with V-blade within one to four hours after the finishing process and before final set without dislodging aggregates. The V-joint shall be 1 (one) inch deep and 3/8 inch wide.

7. Joint Sealant/Filler Strips:

a. All construction joints and isolation joints shall be filled with filler strips.

C. Finishing Formed Surfaces

1. General:

a. The intent is to obtain materials and workmanship of such quality that only nominal finishing will be required to produce concrete surfaces equal to the best obtainable with the concrete and forming material specified.

2. Rough Formed Finish:

a. Standard rough form finish shall be the concrete surface having the texture imparted by the form facing material used, with tie holes and defective areas repaired and patched and all fins and other projections exceeding 1/4 inch in height rubbed down or chipped off.

3. Smooth Formed Finish:

a. Produce smooth form finish by selecting form material to impart a smooth, hard, uniform texture and arranging them orderly and symmetrical with a minimum of seams. Repair and patch defective areas with all fins or other projections exceeding 1/16 inch in height completely removed and smoothed.

b. Apply to concrete surfaces that are to be exposed to public view, or that are to be covered with coating material applied directly to the concrete, or a covering material bonded to the concrete such as waterproofing, dampproofing, painting, or other similar system.

4. Smooth Rubbed Finish:

a. Provide a smooth rubbed finish to surfaces which have received smooth form finish treatment, not later than the day after form removal. **All cast-in-place walls exposed to view shall receive a smooth rubbed finish.**

b. Moisten concrete surfaces and rub with carborundum brick or other abrasive until a uniform color and texture is produced. Do not apply cement grout other than cement paste drawn from the concrete itself by the rubbing process.

5. Related Unformed Surfaces:

a. At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike off smooth and finish with a texture matching the adjacent formed surfaces. Continue the final surface treatment of formed surfaces uniformly across the adjacent unformed surfaces, unless otherwise shown.

D. Finishing Floors and Slabs

1. Floor Slabs in Parking and Driving Areas shall have a medium to heavy Non Slip Broom Finish:

2. Sidewalks and Stair Tower landing slabs shall have a light, non-slip broom finish.

3. Placement and finishing of broom finished slab surfaces shall be as follows:

   a. Placement: The concrete per the approved mix design shall be placed, consolidated and screeded to eliminate high and low spots as recommended per ACI 301 and ACI 302R.

   b. Float Finish: Begin floating when the bleed water sheen has disappeared and the concrete surface has stiffened sufficiently to permit the operation. The finish tolerance shall be per the requirements of ACI 301 and ACI 117. Finish all concrete slab surfaces to proper elevations to insure that all surface moisture will drain freely to floor drains, and that no puddle areas exist.

   c. Non-Slip Broom Finish: Immediately after concrete has received a floated finish, roughen the concrete surface by brooming in the direction perpendicular to the main traffic route or as directed by the Engineer. Use fiber-bristle broom unless otherwise directed. The final texture and finish shall be per the approved mock-up panel. It may be necessary to adjust finishing techniques to duplicate the appearance of the mock-up panel.

4. Slabs in Enclosed Areas and/or Areas to be covered with other Finishes:

   a. Float Finish: After the concrete is placed, consolidated and screeded, apply float finish. The finish tolerance shall be per the requirements of ACI 301 and ACI 117.

   b. Trowel Finish: Apply trowel finish to the slab surface areas and the texture shall be per the mock-up panel appearance accepted by the Architect/Engineer.

   c. Surfaces to be covered with waterproofing membrane systems shall be finished and cured in accordance with the waterproofing manufacturer's recommendation.

E. Miscellaneous Concrete Items

1. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel troweling surfaces to a hard, dense finish with corners, intersection, and terminations slightly rounded.

2. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on the drawings. Set anchor bolts for machines and equipment to template at correct elevations, complying with certified diagrams or templates of the manufacturer furnishing the machines and equipment.

3. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.

F. Concrete Surface Repairs

1. Patching Defective Areas: No patching work shall be done without prior review by the Architect. The Contractor shall submit actual repair locations, procedures and material to be used. The following is a general guideline for concrete repair work.

a. Cut out honeycomb, rock pockets, voids over ½ inch diameter, and holes left by tie rods and bolts, down to solid concrete but in no case, to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Before placing the cement mortar, thoroughly clean, dampen with water, and brush coat the area to be patched with a bonding grout consisting of one part cement, one and a half part fine sand and a 50/50 mixture of the specified bonding admixture and water to achieve the consistency of thick paint.

1) For exposed to public view surfaces, blend white Portland cement and standard Portland cement, when dry, the patching mortar will match the color of the surrounding concrete. Compact mortar in place and strike off slightly higher than the surrounding surface.

b. Proprietary patching compounds may be used in lieu of the cement mortar with prior approval of the Architect and when color match of the adjacent concrete is not required.

2. Remove fins and irregularities in exposed concrete surfaces while concrete is green. Grind smooth and patch with mortar if required, to make surface smooth.

3. Repair of Unformed Surfaces:

a. Slabs with low area and improper slopes to drains shall be corrected by the use of a polymer patching mortar.

1) Sawcut the edges of the defective area to a minimum depth of ½ inch and roughen and clean hardened concrete. Coat surface with bonding grout or bonding compound.

2) Mix polymer repair mortar in strict conformance with manufacturer's instructions.

3) Apply fill to the required thickness and blend into adjacent areas. Finish surface to match surrounding concrete.

b. Repair unformed surfaces that contain defects, which adversely affect the durability of the concrete. Surface defects, such as, include crazing, cracks in excess of 0.01 inch wide or which penetrate to the reinforcement or completely through concrete sections regardless of width, spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.

1) Use high-pressure epoxy injection to repair cracks in beams and girders.

2) Route a "v" groove in cracks at support slabs and slabs on grade, 3/8 inch wide at the top and 3/8 inch deep. Caulk with sealant specified in Section 079200.

3) Use polymer-patching mortar to repair crazing, spalling, popouts, honeycomb, rock pockets and other objectionable surface conditions
.

4. Structural Repair:

a. All proposed structural repairs shall be submitted for approval prior to application.

3.4 FIELD QUALITY CONTROL

A. Quality Control

1. Testing Agency: Owner will engage a qualified independent testing and inspecting agency, approved by the Engineer, to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.

2. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

a. Testing Frequency for Slabs, Slabs-On-Grade, Walls and Concrete In-Fill Washes: Obtain one composite sample for each concrete mix exceeding 5 cu. Yd., but less than 25 cu. Yd., plus one set for each additional 50 cu. Yd. or fraction thereof.

b. Testing Frequency for Footings, Grade beams and Piers: Obtain at least one composite sample for each 50 cu. Yd. or fraction thereof of each concrete mix placed each day.

1) When frequency of testing will provide fewer than five compressive-strength tests for each concrete mix, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

c. Slump: ASTM C 143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.

d. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.

e. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.

f. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of five standard cylinder specimens for each composite sample (for laboratory curing) and one set of three standard cylinder specimens (for field curing).

g. Compressive-Strength Test: ASTM C 39; test two laboratory-cured specimens at 7 days and two at 28 days, retain one laboratory-cured cylinder.

B. Evaluation and Acceptance Criteria

1. Evaluation and acceptance of work under this section shall be in accordance with the provisions of ACI 301 and the following:

2. If the average of any three consecutive strength test results is less than f'c or if any strength test results falls below f'c by more than 500 psi, test a minimum of three ASTM C31 field-cured samples from the in-place work represented by the low test cylinder results and test. Concrete represented by field-cured samples shall be considered structurally adequate if the average of three strength tests is equal to at least 85 percent of f'c and if no single core is less than 75 percent of f'c. Locations represented by erratic

strengths shall be retested by core sampling per ASTM C42. Remove and replace all concrete that fails to meet the specified strength criteria. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

3. Test results shall be reported in writing to the Engineer, concrete manufacturer, and Contractor within 40 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 mix proportions and materials, compressive breaking strength, and type of break for both 7 and 28-day tests.

4. 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.

5. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when tests results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by the Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by the Engineer.

C. Miscellaneous Concrete Requirements

1. All other concrete work indicated on the drawings shall be provided and installed, even though not specifically mentioned herein, to complete the work, including the following:

a. Anchors: Install anchors furnished under other sections in accordance with approved shop drawings and/or setting instructions.

b. Equipment Bases: Install concrete bases for all pumps, tanks, fans, transformers, floor mounted electrical equipment, etc., including anchor bolts and inserts in accordance with setting instructions furnished by the Contractor responsible for installing the equipment. Finish all bases in a workmanlike manner with a troweled finish. The bases shall be located and sizes determined by the Contractor furnishing the equipment.

3.5 CLEANING AND PROTECTION

A. Concrete Curing and Protection

1. General:

a. Protect freshly placed concrete from premature drying and excessive cold or hot temperature, and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.

b. Protect newly finished slabs from rain, snow or wind damage. Protect finished slabs from mortar leakage from pouring of concrete above. Cover masonry walls, glazing, and other finish materials with polyethylene or otherwise protect from potential damage due to placement of concrete.

c. Start initial curing as soon as free moisture has disappeared from the concrete surface after placing and finishing.

d. Begin final curing procedures immediately following initial curing and before the concrete has dried. Continue final curing for at least 7 days and in accordance with ACI 301 procedures. Avoid rapid drying at the end of the final curing period.

2. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces 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.

3. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:

   a. Moisture Curing: Keep surfaces continuously moist for not less than seven days, for slabs, landings sidewalks, pour strips, and all other horizontal cast-in-place concrete with the following materials:

      1) Water.
      2) Continuous water-fog-spray.

      3) Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

4. Moisture-retaining cover curing:

   a. Cover the concrete surfaces with the specified moisture retaining cover for curing concrete, placed in the widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during the curing period using cover material and waterproof tape.

   b. Do not apply covering on finished and broomed surfaces prematurely to prevent damage to finished and broomed surfaces. Finished surfaces adversely affected by curing operations shall be repaired and restored to match the textures and finishes of the approved mock-up. Contractor shall submit proposed repair materials and methodologies for approval prior to application.

5. Liquid curing and hardening compound:

   a. Apply the specified liquid curing and hardening compound immediately after final finishing. Apply uniformly in a continuous operation by power spray equipment in accordance with the manufacturer's direction. Recoat areas, which are subjected to heavy rainfall within 3 hours after initial application. Maintain the continuity of the coating and repair damage to the coat during the entire curing period. Do not use curing or hardening compounds that discolor or stain concrete surfaces.

   b. Coordinate the use of this curing and hardening compound with surfaces, which are to receive subsequent coatings or finishes.

   c. Formed Surfaces: Cure formed concrete surfaces, including the undersides of girders, beams, supported slabs, and other similar surfaces by moist curing with the forms in place for the full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

3.6 EXTRA STOCK/SPARE PARTS (NOT USED)

3.7 SCHEDULES

A. Placement Schedule: Prepare a placement schedule and submit to Architect for review no less than two weeks prior to the pre-concrete conference; Part 2, Section 2.2, Paragraph K, and shall be discussed therein.

END OF SECTION

SECTION 034100

STRUCTURAL PRECAST CONCRETE

PART 1 - GENERAL

1.1 GENERAL REFERENCE

A. The work of this Section is integral with the whole of the Contract Documents and is not intended to be interpreted outside that context.

1.2 DESCRIPTION OF WORK

A. Provide all design, labor, materials, equipment, design services and accessories necessary to furnish and install the work of this section, complete and functional, as indicated in the Contract Documents and as specified herein.

B. Extent of structural precast concrete work is shown on drawings and in schedules and includes the following:

1. Long span double tee units.
2. Structural framing units including columns, beams and girders.
3. Exterior spandrels, wall panels and perimeter columns with architectural finishes.
4. Stairs and solid slab/plank units.
5. Load bearing light-wall and shear wall units.
6. Stair and elevator walls.

1.3 ALTERNATIVES

A. Alternates 1-3 do not affect the precast scope of work.

B. ADD/ALT No. 4: Precast spandrel panels to be 10” shorter with railings for pedestrian fall protection on the east and west elevations. Base bid spandrels 6’-11” without railings. Alternate bid spandrels to be 6’-1” with post-installed railings. North elevation spandrels not affected.

1.4 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 10 00 - Concrete Forming

B. Section 03 20 00 - Concrete Reinforcing

C. Section 03 30 00 Cast-In-Place Concrete

D. Section 04 20 00 – Unit Masonry

E. Section 07 92 00 – Joint Sealants

F. Section 07 95 00 – Expansion Control

1.5 SHOP DRAWINGS

A. Shop Drawings: Submit shop drawings showing complete information for fabrication and installation of precast concrete units. Indicate member dimensions and cross section; location, size and type of reinforcement, including special reinforcement and lifting devices necessary for handling and erection. Shop drawings shall be stamped and signed by a Professional Structural Engineer licensed to practice in the State of Massachusetts.

1. Indicate layout, dimensions, and identification of each precast unit corresponding to sequence and procedure of installation. Indicate welded connections by AWS Standard symbols. Provide location and details of inserts, connections, and joints, including accessories and construction at openings in precast units.

2. Provide location and details of anchorage devices that are to be embedded in other construction. (foundations, structural support members other than precast concrete, etc.) Furnish templates if required for accurate placement.

3. Include temporary shoring, bracing and erection procedure for precast units and sequence of erection. Temporary shoring and bracing plans and details shall include stamped and signed design calculations prepared by the registered Professional Engineer licensed to practice in the State of Massachusetts.

4. Provide mock-up shop drawings reflecting sample of all architectural finishes as identified in paragraph 1.8.

1.6 SAMPLES

A. Initial Selection Samples: Submit samples showing complete range of colors, textures and finishes available for each material used.

B. Verification Samples: Submit representative samples of each material that is to be exposed in the finished work, showing the full range of color and finish variations expected.

C. Submit the following samples:

1. Submit no less than three sets of samples approximately 12 inches x 12 inches x 2 inches to illustrate the quality, color, and texture of the surface finish for each type of architectural finish; exterior spandrels, wall panels and perimeter columns. Initial samples to include both desired color samples as directed.

2. Submit Manufactures thin brick sample selection with complete available color range, texture and finishes including full size samples of selected brick types.

1.7 PRODUCT LITERATURE

A. Product Data: Submit manufacturer's specifications and instructions for manufactured materials and products. Include manufacturer's certifications and laboratory test reports as required.

B. Mix Designs: Submit written reports of proposed concrete mix as specified in Part 2 of this section.

C. Calculations: Provide stamped and signed design calculations including calculations for structural repairs prepared by the registered Professional Engineer licensed to practice in the State of Massachusetts. Precast concrete units and connections shall be designed to withstand all applicable loads required by governing codes and erection conditions.

D. Review Period: Precast Shop Drawings and Calculations shall be subject to the Owners Architect and Engineer. Review period for each submission shall be up to 14 calendar days and reflected in the precast manufacture's schedule.

1.8 MOCK UPS

A. Submit three sets of precast samples for each required color, approximately 12 inches x 12 inches x 2 inches, to illustrate the quality, color, and texture of the surface finish for each Architectural Finish of the structural precast units.

B. Thin Brick Mock-up: Provide 3 ft x 3 ft mock-up boards depicting thin brick color range, blend, texture, patterns and mortar joint color, size, and configuration. Mock-up shall be representative fo surface preparation techniques, forms and workmanship. Do not proceed with remaining work until workmanship, color, blend, jointing are approved by the architect. If directed by the architect, provide subsequent mock-up boards to achieve final approval.

C. Full Scale Mock-Up Panels: Upon approval of small sample panels, and before fabrication of any other architectural precast concrete work commences, fabricate two (2) mockups in accordance with the mockup detail as shown on A-002 for inspection by the Owner and Architect. The mockups are to display all exposed, exterior finishes featured on the garage and align with the provided mock-up drawing. If the range of color and applied finish on the panels is approved by the Architect, one mock-up panel shall remain at the precaster's plant and be used as a standard of quality for architectural finish of the structural precast concrete work required for this project. The second mock-up panel shall be delivered and stored on-site at a location designated by the Architect and remain on site for use as a standard of quality through the delivery, erection and punch-listing phases of the project. The precaster shall provide and assemble materials to maintain sample panel in upright position throughout the project duration. Fabrication of the precast work shall not commence until the mock-up panel has been approved by the Architect. At the conclusion of the project, the panel shall be removed and disposed of in a legal manner. The precast manufacture shall notify the Architect at least 2 weeks in advance of casting of the mock-up panel.

D. The initial casting of the precast tees may serve as the mock-up for review for the finishes including the surface broom finish. The precaster shall notify the Architect at least 2 weeks in advance of casting of the initial precast tees.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver precast concrete units to project site in such quantities and at such times to assure continuity of installation. Store units at project site to prevent cracking, distortion, staining, or other physical damage, and so that markings are visible. Lift and support units at designated lift points.

B. Deliver anchorage items, which are to be embedded in other construction before start of such work. Provide setting diagrams, templates, instructions and directions as required for installation.

1.10 COORDINATION (NOT USED)

1.11 QUALITY ASSURANCE

A. Manufacturer's qualifications.

1. Fabricator Qualifications: Firms which have five years successful experience in fabrication of precast concrete units similar to units required for this project will be

acceptable. Fabricator must have sufficient production capacity to produce required units without causing delay in work.

a. Fabricator must be producer member of the Prestressed Concrete Institute (PCI) and/or participate in its Plant Certification Program.

b. Each facility utilized must be certified for the type of product produced.

B. Subcontractor's qualifications

1. Erector Qualifications: The erector must be certified by PCI and shall have five years successful experience in the erection of precast concrete units similar to those required for this project. Submit proof of current erection certification certified for complex structural systems.

a. Welder Qualifications: Field Welder shall be certified on the material and for the type of welding performed. Proof of current certification shall be submitted no less than two weeks prior to start of welding.

C. Engineering:

1. Codes and Standards: Comply with provisions of following codes, specifications and standards, except as otherwise indicated.

a. 780 CMR: Massachusetts Amendments to the International Building Code 2009

b. ACI 301 "Specifications for Structural Concrete".

c. ACI 318 "Building Code Requirements for Structural Concrete".

d. Concrete Reinforcing Steel Institute, "Manual of Standard Practice".

e. Prestressed Concrete Institute MNL 116, Manual for Quality Control for Plants and Production of Precast Concrete Products".

f. Prestressed Concrete Institute MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products".

g. Prestressed Concrete Institute MNL 135, "Tolerance Manual for Precast and Prestressed Concrete Construction".

h. Prestressed Concrete Institute, MNL 120, "PCI Design Handbook".

i. American Welding Society, AWS D1.1, "Structural Welding Code-Steel", D1.4 "Structural Welding Code – Reinforcing Steel", D1.6 "Structural Welding Code – Stainless Steel", C5.4, "Recommended Practices for Stud Welding".

2. Analysis and Design by the Professional Structural Engineer retained by the Fabricator: The Professional Engineer shall have a minimum of five years of experience in designing Precast Concrete Parking Structures.

3. All precast concrete units and precast concrete structural frame shall be analyzed and designed by the fabricator to support self-weight, superimposed dead, live and impact loads, volume change and thermal loads, handling loads and lateral (including but not limited to wind and seismic) loads as required for compliance with the governing Building Code.

4. For precast concrete structures where stability of the structure and the structural resistance to the lateral loads in accordance with the governing Building Code is to be provided by the precast concrete components, walls, frames, braces, etc., either by themselves or in combination with other structural members, the precast concrete fabricator shall analyze the structure in accordance with the structural system identified in the contract documents. The fabricator shall calculate lateral loads as required by the Building Code to be used in such analysis.

5. The precast concrete fabricator shall provide complete analysis and design calculations prepared and stamped by the Registered Engineer, licensed in State where project is located. The information in the calculations shall be paginated, provided with the index page, and shall include the following as a minimum:

   a. Sketches of structural system(s) which have been analyzed.

   b. Calculation of the required gravity and lateral loads.

   c. Sketches of models analyzed (with node and member numbering per computer analysis, if used).

   d. Summary of material and member properties and boundary conditions assumed.

   e. Summary of individual loadings and load combinations.

   f. Reactions at supports and connections due to the loading combinations considered.

   g. Forces in most critical individual members due to the loading combinations considered.

   h. Design calculations of representative connections and member reinforcement.

   i. (Where word “Fabricator” is used, it means the Engineering Work to be done by the approved Professional Engineer retained by the Fabricator.)

D. Fire Resistance Rated Precast Units: Where precast concrete units required by Code to meet a particular fire resistance classification, provide units tested and listed by U.L. in "Fire Resistance Directory", with each unit bearing U.L. label and marking, or in accordance with PCI Manual, MNL – 124, “Design for Fire Resistance of Precast Prestressed Concrete”.

   1. Provide complete design calculations by the Professional Engineer registered in the State where the Project is located.

E. The fabrication of precast concrete will be performed under a Quality Assurance program, including monitoring, inspecting, testing, and documenting production of elements according to the Project Specifications. The Fabricator of the precast concrete shall be certified by the Precast/Prestressed Concrete Institute (PCI). The Testing Agency will certify and document the following:

   1. Location and installation details of the reinforcing and prestressing steel.

   2. Application of prestressing forces.

3. Grouting (non-shrink and dry pack) at column and pier bases, and at all joints.

4. Grouting at embedded inserts and splice sleeves.

5. Location and installation of inserts and blockouts.

6. Plant concrete mix design.

1.12 WARRANTIES

A. Attention is directed to provisions of the CONDITIONS OF CONTRACT and applicable parts of Division 1 regarding guaranties and warranties.

B. Manufacturers shall provide their standard guaranties for work specified in this Section. However, such guaranties shall be in addition to and not in lieu of all other liabilities which manufacturers and Contractor may have by law or by other provisions of the Contract Documents.

PART 2 - PRODUCTS

2.1 ACCPETABLE MAUNFACTURERS (NOT USED)

2.2 MATERIALS

A. Formwork

1. Provide forms and where required, form facing materials of metal, plastic, wood, or other acceptable material that is non reactive with concrete and will produce required finish surfaces.

2. Accurately construct forms, mortar tight, of sufficient strength to withstand pressures due to concrete placing operations, temperature changes, and when prestressed, pretensioning and detensioning operations. Maintain formwork to provide completed precast concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified in PCI MNL.

B. Reinforcing Materials

1. Reinforcing Bars: ASTM A615, Grade 60, unless otherwise indicated. Reinforcement to be welded shall conform to ASTM A706 Grade 60.

2. Steel Wire: ASTM A82, plain, cold drawn, steel.

3. Welded Wire Fabric: ASTM A185.

4. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers and other devices for spacing, supporting and fastening reinforcing, complying with CRSI recommendations.

a. Epoxy Coated: ASTM A775/A. Fusion bonded coating, apply after fabrication and bending. Film thickness of coating after curing to be 7 to 12 mils when measured in accordance with Method G12. Provide epoxy coated reinforcing as defined below.

1) All reinforcement except welded wire fabric, placed within the top 3" of elevated structural slabs including precast double tees, beams and girders.

2) All reinforcement extending from precast concrete components into the cast-in-place concrete topping.

3) Support steel for all epoxy coated reinforcing steel.

b. Epoxy Patching Compound: ASTM A775/A.

C. Pre-stressing Tendons

1. Uncoated Grade 270, 7-wire stress relieved strand complying with ASTM A416.

2. Strand similar to above, but having size and ultimate strength of wires increased so that ultimate strength of the strand is increased approximately 15 percent, or strand with increased strength but with fewer number of wires per strand, may be used at manufacturer's option.

D. Concrete Materials

1. Portland Cement: ASTM C150, Type I or Type III.

a. Use only one brand and type of cement, fly ash and round granulated blast furnace slag throughout project, unless otherwise acceptable to Architect.

b. Uniformity of cured concrete appearance resulting from the concrete mix and its constituents, manufacturing or handling practices is the manufacturer's responsibility.

2. Aggregates: ASTM C33, and as herein specified. Provide aggregates from a single source for exposed concrete.

3. Water: Potable.

4. Air Entraining Admixture: ASTM C260.

5. Water Reducing Admixture: ASTM C494, Type A, or other Type approved for fabricator's units.

6. Corrosion Inhibiting Admixture: ASTM C494/C Type C. Application rate of 2 1/2 gal/cy of concrete for precast units used in horizontal applications only including double tees, beams and girders.

7. Pigment admixtures: natural and synthetic materials conforming to ASTM C979. Not to exceed 10% by weight of cement, exterior formed finish panels and exterior sand blast finish shall have colored concrete as selected by the Architect.

E. Connection Materials

1. Carbon Steel Shapes and Plates: ASTM A36.

2. Anchor Bolts: ASTM A307, low carbon steel bolts, regular hexagon nuts and carbon steel washers.

a. Galvanized: Provide ASTM A307, hot-dip zinc coated, with ASTM A563 heavy hex nuts and carbon steel washers, hot-dip galvanized ASTM A153.

3. Threaded Fasteners: ASTM A307 or A325 heavy hexagon structural bolts, heavy hexagon nuts and washers.

   a. Galvanized: ASTM A307 or A325, with ASTM A563 heavy hex nuts and carbon steel washers, hot-dip galvanized ASTM A153.

4. Bolts at column splices: For anchoring columns within a 2'-0" height above a respective floor level, stainless steel anchor bolts conforming to ASTM F593, Group A, Type 304 shall be used together with corresponding stainless steel nuts and washers. For column splices outside of the 2'-0" zone above any floor level, see paragraph 3 above, or the use of mechanical splice sleeves meeting ACI 318, 12.14.3.2.

5. Bearing Pads: Provide bearing pads for precast concrete units as indicated on drawings.

   a. Elastomeric Pads: Vulcanized, chloroprene elastomeric compound, molded to size or cut from a molded sheet, 50 60 shore A durometer.

   b. Frictionless Pads: Tetrafluoroethylene (TFE), with glass fiber reinforcing as required for service load bearing stress.

   c. Random Oriented Fiber Reinforced: Shall support compressive stress of 3,000 psi with no cracking, splitting or delaminating in internal portions of the pad. One specimen shall be tested for every 100 pads used.

   d. Cotton Duck Layer Reinforced: Elastomeric pads with closely spaced layers of fabric meeting AASHTO specification section 18.10.2.

   e. Plastic: Multi-monomer plastic strips shall be non-leaching and support construction loads with no visible overall expansion. Limit to plank bearing only.

   f. Tempered or Untempered Hardboard: Limit use to plank bearing only. Do not use in areas where bearing material in service may remain wet for extended periods of time.

6. Tee Flange Connection: Plates and bars; stainless steel per ASTM A666, AISI Type 304, or ASTM A276 Type 304 or 304N.

7. Welding Electrodes: Comply with AWS standards.

8. Accessories: Install clips, hangers, and other accessories required for installation of project units and for support of subsequent construction or finishes as supplied to the precast manufacture by others.

F. Grout Materials

1. Cement Grout: Portland cement, ASTM C150, Type I, and clean, natural sand, ASTM C404. Mix at ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum water required for placement and hydration.

2. Non-metallic, Shrinkage Resistant Grout: Pre mixed, non-metallic, non-corrosive, non-staining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with ASTM C1107 and U.S. Army Corps of Engineers CRD-C621.

a. Available Products: Subject to compliance with requirements, products, which may be incorporated in the work, include, but are not limited to, the following:

1) Euco N.S.: The Euclid Chemical Co.

2) Crystex; L & M Construction Chemicals

3) Masterflow 713 Plus; Master Builders

4) Five Star Grout; U.S. Grout Corp.

G. THIN BRICK MATERIALS

1. Thin Brick Units: ASTM C 1088, Grade Exterior, Type TBX, not less than 9/16 inch thick, and as follows:

a. Basis of design: Feldhaus Klinker 991 “Bacco | Ador Matiz”

b. Face Size: 2-1/4 inches high by 7-5/8 inches long.

c. Special Shapes: Include corners, edge corners, and end edge corners.

d. Initial Rate of Absorption: Less than 30g/30 sq. in. per minute when tested per ASTM C 67.

e. Efflorescence: Provide thin brick units that meet ASTM C 67 and is rated “not effloresced”.

f. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to the following:

1) Feldhaus

2) Summitville Thin Brick

3) Endicott

4) or approved equal

2.3 MIXES

A. Prepare design mixes for each type of concrete required in conformance with the requirements of the Plans and Section 03 30 00 Cast-in-Place Concrete.

1. Design mixes may be prepared by independent testing facility or by qualified precast manufacturing plant personnel, at precast manufacturer's option

B. Produce standard weight concrete consisting of specified Portland cement, aggregates, admixtures, and water to produce the following minimum properties.

1. Compressive strength; 5000-psi minimum at 28 days. Release strength for prestressed units: 3500 psi.

2. Cure compression test cylinders using same methods as used for cast-in-place concrete work, and as required by PCI & ASTM C31.

C. Submit written reports to Architect of proposed mix for each type of concrete at least 15 days prior to start of precast unit production. Do not begin concrete production until mixes and evaluations have been reviewed by Architect.

D. Adjustment to Concrete Mixes: Mix design adjustments may be requested when characteristics of materials, job conditions, weather, test results, or other circumstances warrant. Laboratory test data for revised mix designs and strength results must be submitted to and accepted by Architect before using in the work.

E. Admixtures:

1. Use air entraining admixture in concrete and shall conform to the air content limits indicated in the plan documents.

2. Use water reducing admixtures in strict compliance with manufacturer's directions. Admixtures to increase cement dispersion, or provide increased workability for low slump concrete, may be used subject to Architect's acceptance.

3. Use amounts as recommended by admixture manufacturer for climatic conditions prevailing at time of placing. Adjust quantities of admixtures as required to maintain quality control.

F. Chloride Ion Content of Design Mix (ASTM C1218): For the purposes of this sub-section only, compliance to the requirements below shall be provided for elements of the structure exposed to the chloride ions in service. These include among others, precast concrete double-tees, double-ledger beams, single-ledger beams, spandrel beams, hollow-core slabs/planks, walls and columns in parking areas, reinforced concrete walls, columns and piers in parking areas, and cast-in-place concrete topping.

1. For protection against corrosion, maximum water soluble chloride ion concentration in hardened concrete at 28 days shall be limited to quantities indicated in the ACI 318 Table 4.4.1, except that percentages listed shall be taken against the weight of cementitious materials (Portland Cement plus Fly Ash or other pozzolans, plus GGBFS).

2. Mixes with the water soluble chloride ion concentration in excess of the limits per ACI 318 Table 4.4.1 as determined by testing per ASTM C1218, will not be accepted. The contractor shall identify the source of the excess chloride ions (aggregates, water, admixtures, etc.) take measures to remove it from the affected mix(es).

G. Stair treads: Two component stair noising mill finish aluminum to accommodate pre-installation of aluminum extruded base to be cast into the concrete step with wood blocking during construction and finished stair nosing at time of occupancy: Balco XH-330 2626 S. Sheridan, Wichita Kansas 67217, (316) 945-9328, Babcockdavis BSTTF, Brooklyn Park, MN 55428 (888) 412-3726 or approved equal.

2.4 FABRICATION

A. General: Fabricate precast concrete units complying with manufacturing and testing procedures, quality control recommendations, and dimensional tolerances of PCI MNL 116, and as specified for types of units required.

B. Ready Mix Concrete: Comply with requirements of ASTM C94, and as herein specified.

1. Delete references for allowing additional water to be added to batch for material with insufficient slump. Addition of water to batch will not be permitted.

2. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required when the air temperature is between 85 deg. F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1 1/2 hour to 75 minutes and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

C. Built in Anchorages: Accurately position built in anchorage devices and secure to formwork. Locate anchorages where they do not affect position of main reinforcement or placing of concrete. Do not relocate bearing plates in units unless acceptable to Architect.

1. Lifting devices shall be placed and cast so as not to weaken the unit during manufacturing, handling and erection. Such devices shall not interfere with the erection or placing of the unit in its final position in the building. These devices shall also be protected from rusting, or other deterioration or damage. Under no circumstances shall these devices be visible in the completed work.

D. Cast in Holes for openings larger than 10" diameter or 10" square in accordance with final shop drawings. Provide sleeves for horizontal electrical conduit runs and plumbing lines as required. Holes in precast flanges and other small holes that will be field cut by trades requiring them will not be allowed without prior approval by the Architect/Engineer and the Precast Concrete Manufacturer. See Part 3 of this Section for additional information.

E. Coat Surfaces of forms with bond breaking compound before reinforcement is placed. Provide commercial formulation form coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces requiring bond or adhesion. Apply in compliance with manufacturer's instructions.

F. Clean reinforcement of loose rust and mill scale, earth and other materials, which reduce or destroy bond with concrete.

G. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.

H. Cast-in materials for other trades:

1. Hardware, conduit, inserts and similar materials required by other trades shall be located and detailed on the shop drawings by the Precast Manufacturer. Hardware, conduit inserts and similar materials required by other trades shall be furnished to Precast Manufacturer by the trade in a timely manner that accommodates the Precast Manufacturers schedule. Precast Manufacturer shall not cast precast components without hardware, conduit, inserts and similar materials as identified on approved shop drawings.

I. Place reinforcement to obtain at least the minimum cover for concrete protection per ACI 318. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.

J. Pretensioning of tendons for prestressed concrete may be accomplished either by single strand tensioning method or multiple strand tensioning method. Comply with PCI MNL 116 requirements.

K. Place concrete in a continuous operation to prevent formation of seams or planes of weakness in precast units, complying with requirements of ACI 304R. Thoroughly consolidate placed concrete by internal and external vibration without dislocation or damage to reinforcement and built in items.

L. Identification: Provide permanent markings to identify pick up points and orientation in structure, complying with markings indicated on final shop drawings. Imprint date of casting on each precast unit on a surface, which will not show in finished structure.

M. Curing by low pressure steam, by steam vapor, by radiant heat and moisture, or other similar process may be employed to accelerate concrete hardening and to reduce curing time.

N. Delay detensioning of prestressed units until concrete has attained at least 3500 psi or higher as required by design.

1. If concrete has been heat cured, perform detensioning while concrete is still warm and moist to avoid dimensional changes which may cause cracking or undesirable stresses in concrete.

2. Detensioning of pretensioned tendons may be accomplished either by gradual release of tensioning jacks or by heat cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.

O. Finish of Formed Surfaces: Provide finishes for formed surfaces of precast concrete as indicated for each type of unit, and as follows:

1. Standard Finish: Tees, Beams, Girders and Interior Columns Normal plant run finish produced in forms that impart a smooth finish to concrete. Small surface holes caused by air bubbles, normal form joint marks, and minor chips and spalls will be tolerated, but no major or unsightly imperfections, honeycomb, or structural defects will be permitted.

2. Architectural Finish: All exterior precast units including but not limited to columns, girders, shear walls, wall panels, stair towers and spandrels shall be cast and finished to produce an structural precast finish as follows:

a. Colored Units: Precast units shall have a sandblast finish as directed by the Architect and approved on the mock-up. Where indicated on the drawings, exterior precast color and texture shall meet approved sample with selected sandblast finish.

1) Samples shall assimilate in color and textures as shown in 363 & 364 in the Architectural Precast Concrete, Color and Texture Selection Guide, 2nd Edition, Precast/Prestressed Concrete Institute, 2010. The selected color will be in the same family of colors as 363 & 364. Reference drawings for finish schedule and elevations.

a) Finish Type A: Typical exterior precast finish with medium sandblast Basis of Design 363AE-L & 364AE-L
b) Finish Type B: Polished aggregate finish at spandrel inset at East and West Elevations. Basis of Design 363P & 364P

2) Precast units shall be uniform in appearance, color and texture to match sample panels and mock-up prepared by the Precaster and approved by the Owner and the Architect.

b. Interior face of spandrel and wall panels shall receive a smooth troweled finish, unless otherwise noted.

P. Finish of Unformed Surfaces: Apply trowel finish to unformed surfaces unless otherwise indicated. Consolidate concrete, bring to proper level with straightedge, float and trowel to a smooth uniform finish. No surfaces exposed to freeze-thaw cycles in service shall be finished with power equipment, unless evidence acceptable to the Architect/Engineer presented by the manufacturer that such a finishing does not reduce the amount of air entrainment in the top 1/8" of precast concrete.

1. Provide a medium to heavy broom finish on tees parallel with the long direction of the unit as approved by the mock-up.

2. Provide an intentionally roughened surface (1/4" amplitude) on tees and beams to receive a concrete topping, where indicated on drawings and where required or determined by the precaster for erection/construction.

Q. For Structural Precast with architectural finish: Comply with the dimensional tolerances of PCI MNL 116.

R. Long Span Units

1. Type: Plant fabricated, precast prestressed double tee concrete units, produced under rigid, factory inspected process. Precast tee units shall include 4" tee flange with an overall depth not less than 2 ft. – 10 in.

2. Furnish units, which are free of voids or honeycomb, with straight true edges and surfaces.

3. Provide "Standard Finish" units as specified.

4. Where ends of strands will not be enclosed or covered, cut flush and cover with high strength mortar, bonded to unit with epoxy resin bonding agent.

5. Adequately reinforce units to resist transporting and handling stresses.

6. Include cast in weld plates where required for anchorage or lateral bracing to framing units and adjacent precast members.

7. Coordinate with other trades for installation of items to be cast in long span units. Include drain frame cast into precast double tees, Zurn Model No. 662 or approved equal in quantities as indicated on the plan documents. Balance of drain body to be shipped to site for installation by others.

8. Provide block outs for openings in accordance with design drawings or precast unit manufacturer's recommendations. Including block outs for conduit runs as shown on plan documents or, if not detailed, at 1/3rd points.

S. Structural Framing Units

1. Type: Plant fabricated precast prestressed column, girder, floor and stair slab panels, wall panels and spandrel units produced under a rigid factory inspected process.

2. Furnish units, which are free of voids or honeycomb, with straight true edges and surfaces.

3. Provide "Standard Finish" or “Architectural Finish” units as specified.

4. Where ends of strands will not be enclosed or covered, cut flush and cover with a high strength mortar bonded with an epoxy resin-bonding agent.

5. Adequately reinforce units to resist transporting and handling stresses.

6. Include cast in weld plates where required for anchorage or lateral bracing to other supporting members.

7. Coordinate with other trades for the installation of items to be cast in precast structural framing units.

PART 3 - EXECUTION

3.1 PREPARATION AND INSPECTION

A. Inspection:

1. Welding and Materials: Inspection of welding by the Testing Agency will be such as to assure that the work conforms to specified requirements, and will include:

a. Confirmation that electrodes used for manual shielded metal-arc welding and the electrodes and flux used for submerged arc welding conform to the requirements of the specifications.

b. Confirmation that the approved welding procedure and the approved welding sequence are followed without deviation, unless specific approval for change is obtained by the Architect.

c. Confirmation that the welding is performed only by welding operators and welders who are properly certified. The Testing Agency shall witness such qualification testing of welding operators and welders, as may be required.

d. Confirmation that the fit-up, joint preparation, size, contour, extent and length and location of welds conform to Project requirements and where applicable, the contract drawings, and that no welds are omitted or unspecified welds added without approval of the Architect.

e. Verify that quality of welds meet the requirements of paragraph 6.9, table 6.1, “Quality of Welds”, AWS D1.1.

f. The Inspector shall be notified in advance of the start of operation subject to inspection and verification.

g. The testing agency shall test the field welds as follows:

1) All welds, including wall and shoring connections: 100% visual (subject to Table 6.1 “Visual Inspection Acceptance Criteria).

2) All full or partial penetration groove welds: 100% ultrasonic or as directed by the Architect (subject to Table 6.2 “Ultrasonic Acceptance-Rejection Criteria).

3) All other welds, including curtain wall and shoring connections: 10% magnetic particle (10% dye-penetrant for stainless steel).

h. Additional testing will be required of:

1) If more than 10 percent of the ultrasonically inspected welds are rejected, then 100 percent of all such welds shall be ultrasonically tested after the repairs.

2) All cost of additional inspection required by this paragraph shall be borne by the Contractor.

i. In addition, if defective welds are discovered, the remaining uninspected welds may, at the Engineers direction, receive such ultrasonic or magnetic particle inspection.

j. The welding inspector will have the authority to reject weldments. Such rejection may be based on visual inspection where in his opinion the weldment would not pass a more detailed investigation.

k. Reports by the Testing Agency's inspector will contain, as a minimum, an adequate description of each weld tested. The report shall have the identifying mark of the welder responsible for the weld, a critique of any defects noted by visual inspection or testing, and a statement regarding the acceptability of the weld tested, as judged by current AWS standards. Reports shall be distributed as early as possible by not later than one (1) work week after the tests have been performed. The Engineer shall be notified by phone if, in the judgment of the inspector, test results require immediate comment.

l. Radiographic testing may be substituted for ultrasonic.

B. Bolted Connections: Visually inspect all bolted connections to ascertain that all bolts, nuts and required washers have been installed and are of proper type and that all faying surfaces have been brought into snug contact.

C. Precast Concrete:

1. Note that required inspections and tests for embedded steel (carbon and stainless) connections and materials associated with precast concrete elements are included under the Welding and Material of this program.

D. The Contractor and the Testing Agency will perform erection inspections of all precast concrete installation. The Contractor will record inspection results and retain them on-site and submit a copy to the SER.

E. At the start of field operations, and periodically during the course of work, the Testing Agency will conduct compression tests of grout prisms in accordance with ASTM C 109. A set of five (5) grout prisms shall be cast for the first day's work for each grout application (non-shrink and dry-pack grout at joints, grout at inserts and splice sleeves). Another three (3) grout prisms shall be cast for each additional day's work. There shall be a minimum of three (3) grout prism cast, in addition to the initial five (5), for the project. Provide an additional set of five (5) prisms for each change in mix proportions, mix methods, or materials. The prisms shall be delivered to the Testing Agency within 24 hours of placement and shall be tested at 7-days and 28-days, with one prism held in reserve.

3.2 WORKMANSHIP, PERFORMANCE

A. The Owner may employ a separate testing laboratory to evaluate precast manufacturer's quality control and testing methods.

B. The precast manufacturer shall allow Owner's testing facility access to materials storage areas, concrete production equipment and concrete placement and curing facilities. Cooperate with Owner's testing laboratory and provide samples of materials and concrete mixes as may be requested for additional testing and evaluation.

C. Dimensional Tolerances: Units having dimensions smaller or greater than required, and outside specified tolerance limits of MNL 116, will be subject to additional testing as herein specified.

D. Precast units having dimensions greater than required will be rejected if appearance or function of the structure is adversely affected, or if larger dimensions interfere with other construction. Repair, or remove and replace rejected units as required to meet construction conditions.

1. Precast units having dimensions smaller than required will be rejected unless directed otherwise by the Architect.

E. Strength of Units: The strength of precast concrete units will be considered potentially deficient if the manufacturing processes fail to comply with any of the requirements which may affect the strength of the precast units, including the following conditions.

1. Failure to meet compressive strength tests requirements.

2. Reinforcement, and pretensioning and detensioning of tendons of prestressed concrete, not conforming to specified fabrication requirements.

3. Concrete curing, and protection of precast units against extremes in temperature, not as specified.

4. Precast units damaged during handling and erection.

F. Testing Precast Units: When there is evidence that strength of precast concrete units does not meet specification requirements, the concrete testing service shall take cores drilled from hardened concrete for compressive strength determination, complying with ASTM C42 and as follows.

1. Take at least three representative cores from precast units of suspect strength, from locations directed by Architect.

2. Test scores in a saturated surface dry condition per ACI 318 if concrete will be wet during use of completed structure.

3. Test scores in an air dry condition per ACI 318 if concrete will be dry during use of completed structure.

4. Strength of concrete for each series of cores will be considered satisfactory if their average compressive strength is at least 85 percent of 28 day design compressive strength.

5. Test results will be made in writing on same day that tests are made, with copies to Architect, Contractor, and precast manufacturer. Include in test reports the project identification name and number, date, name of precast concrete manufacturer, name of concrete testing service, identification letter, name, and type of member or members

represented by core tests, design compressive strength compression breaking strength and type of break (corrected for length diameter ratio), direction of applied load to core with respect to horizontal plan of concrete as placed, and moisture condition of core at time of bearing.

G. Patching: Where core test results are satisfactory and precast units are acceptable for use in work, fill core holes solid with patching mortar, and finish to match adjacent concrete surfaces.

H. Defective Work: Precast concrete units which do not conform to specified requirements, including strength, tolerances, and finishes, shall be replaced with precast concrete units that meet requirements of this section. Contractor shall also be responsible for cost of corrections to other work affected by or resulting from corrections to precast concrete work.

I. Repair Work: If repairs are required for any precast concrete member after casting, the Contractor shall submit a description of the repair (E.G. crack, spall, etc.) and a detailed description of the proposed fix to be used for Architect's review. Specific repair details should be stamped and signed by Professional Engineer registered in the state of the project and approved by the architect/engineer prior to work commencing.

1. Mock-up: Upon acceptances by the Architect of the Contractor's repair procedure, repairs shall be made for Architect review on the project markup in accordance with the accepted procedure upon acceptance; the repairs shall be maintained as a standard of acceptance for all future repairs of this type.

J. Precast Fabricator shall employ a licensed surveyor registered in the state of Massachusetts to survey and verify alignment, placement and elevations of erected precast units for compliance to the tolerance limits of PCI MNL-127 and PCI MNL-120. Precaster and erector shall provide timely access for the surveyor to verify tolerance compliance and to notify Architect, precaster and erector of non-complying erected precast units. Precaster and/or precaster's erector shall correct all non-complying conditions. Survey and tolerance reports shall be submitted to the Architect at the close of each day's work.

K. Precast fabricator shall survey all anchor bolts, embeds, plates, footing and pier locations, alignments and elevations for conformance to precast layout. Precaster shall notify contractor at least 2 weeks prior to precast erection of all non-conforming conditions to allow contractor sufficient time to implement adjustments.

3.3 INSTALLATION / APPLICATION / ERECTION

A. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections of sufficient strength to bear imposed loads during erection. All columns are to be braced in all directions prior to erecting other members. Remove temporary members and connections when permanent members are in place and final connections are made. Provide temporary guy lines to achieve proper alignment of structures as erection proceeds.

B. Bearing Pads: Install flexible pads where indicated, as precast units are being erected. Set pads on level, uniform bearing surfaces and maintain in correct position until precast units are placed. Stacking or multiple bearing pads, or use of high density plastic shims except at grade and wall panels, shall not be allowed. Erector shall have sufficient pads of varying thicknesses to enable continuous erection within design tolerances. Bearing pad thicknesses shall be evaluated for loading and shape factor by precasters Engineer. Submit bearing pad evaluation with precast design calculations. Multiple shims, pads or any combination at double tee and girder locations shall be removed and replaced with approved pad thickness.

C. Welding: Perform welding in compliance with AWS D 1.1, including qualification of welders.

1. Protect units from damage by field welding or cutting operations and provide non combustible shield as required.

2. Zinc coated (galvanized) surfaces shall be properly prepared for welding by grinding the coating and ascertaining no inclusion of zinc into any weld.

   a. Surfaces where zinc coating has been either removed for welding or damaged due to handling shall be repaired. Repair damaged metal surfaces by cleaning in accordance with SSPC-SP6 and applying a coat of approved galvanizing repair compound. Where cleaning per SSPC-SP6 is impractical, use SSPC-SP3 standard. In all instances of coating repair on shop galvanized surfaces, the surface preparation prior to coating application as well the application of the coating shall be witnessed by the Owner's Testing Agency per Section 014500 of these Specifications.

D. Powder Actuated Fasteners: Do not use powder actuated fasteners for surface attachment of accessory items in precast, prestressed unit unless otherwise accepted by precast manufacturer.

E. Erection Tolerances: Install precast units without exceeding tolerance limits specified in PCI MNL 127 "Recommended Practice for Erection of Precast Concrete" or PCI MNL-120 Chapter 8.

F. Grouting Connections and Joints: After precast concrete units have been placed and secured, grout open spaces at connection and joints as follows:

   1. Non structural joints: The joints shall be grouted with material per Part 2, section 2.2, F.

   2. Structural joints: shrinkage resistant grout consisting of premixed compound and water to provide a flyable mixture without segregation or bleeding.

   3. Provide forms or other acceptable method to retain grout in place until sufficiently hard to support itself. Pack spaces with stiff grout materials, tamping until voids are completely filled. Recess grout within joints to allow no less than ½ inch depth of sealant application into joint in addition to all miters, chamfers, and beveled edges. Example: ¾" miter + ½" sealant = 1 ¼" min. depth to hold grout from face of panel. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it hardens.

G. Close coordination and cooperation must be maintained between the General Contractor and the Precast Concrete Fabricator to overcome any physical obstructions in the area of the work which would prevent suitable access for trucks and cranes in the delivery, receipt and placing of the precast material.

H. Any attachments made to the precast units in the field must be accepted by the Precast Concrete Fabricator as well as the Architect/Engineer to avoid cutting or otherwise damaging the prestressing tendons or reinforcing steel.

I. If field cut openings are required by the Contractor, the Contractor shall coordinate with the Precast Concrete Fabricator. Locations and sizes shall be approved by the Architect/Engineer.

3.4 FIELD QUALITY CONTROL (NOT USED)

3.5 CLEANING AND PROTECTION

A. Precast panels, spandrels, planks and tees that are broken, cracked or chipped shall be repaired or replaced, as directed by the Architect/Engineer.

B. After erection and grouting is completed the Contractor shall be responsible for the protection of slabs and wall panels.

C. Surfaces to receive topping shall be clean and thoroughly wetted prior to placing topping slab.

D. Patch lifting pockets, inserts and other openings to within ½ in. of surface (to allow for caulking) with patching mortar blended to match the color of the surrounding concrete. See Section 033000 for patching materials.

E. Patch defective areas with cement mortar and bonding agents as specified in Section 033000. Blend patching mortar to match surrounding area.

1. Repair or patch concrete with architectural finishes with mortar material identical in color to precast members so that when dry, the repair will match surrounding concrete surface.

F. Repair procedures, materials and analysis for structural repairs shall be submitted and accepted prior to application. All design work for structural repairs shall bear the fabricators engineer professional engineers stamp in the state where the project is located.

G. Remove rubbish and debris resulting from precast concrete work from premises upon completion. Protect work of this Section from fabrication to the completion of installation.

3.6 EXTRA STOCK/SPARE PARTS (NOT USED)

3.7 SCHEDULES (NOT USED)

END OF SECTION

SECTION 04200

UNIT MASONRY
(Filed Sub-Bids Required)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Examine all Drawings and all Sections of the Specifications and requirements and provisions affecting the work of this Section.

1.2 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.
   1. The Work of this section is shown on Drawings: A101, A301, A401, A502, A701, S005, S104, S105, S140, S201.

B. Sub-sub Bids are not required for this trade.

1.3 SUMMARY

A. The extent of each type of unit masonry work is shown on the drawings and includes but is not limited to the following:
   1. Concrete masonry units.
   2. Building in metal doorframes.

B. Related Work Specified Elsewhere:
   1. Section 03300 - Cast-in-Place Concrete
   2. Section 03410 - Structural Precast Concrete
   3. Section 05500 - Miscellaneous Metals
   4. Section 07920 - Joint Sealants
   5. Section 08113 - Hollow Metal Doors and Frames

1.4 QUALITY ASSURANCE

A. Masonry operations are controlled in accordance with the Standard and Project Specification Sections 04180. Specific inspections and tests performed during masonry operations are as follows:
   1. Materials: The Contractor will submit certified test reports for each type of concrete masonry unit. The Testing Agency shall qualify the materials used for masonry production. Grout and mortar mix proportions shall be approved by the SER. Records of the material and mix proportions shall be maintained on file in the Project Office. No alternate materials or mix proportions will be used unless approved by the Testing Agency and the SER.
   2. Construction Operations: At the start of field operations, and periodically during the course of work, the Testing Agency will test materials and conduct inspections of measuring, mixing, laying, and curing of mortar and grout, including prism tests in accordance with

ASTM C 952, ASTM E 447 (Method B), and ASTM C 109. A set of five (5) grout prisms shall be cast at the start of construction; with two prisms compression tested at 7-days, two at 28-days, and one held in reserve. Another three (3) grout prisms shall be cast for each 5,000 square feet of wall area, or each 30 cubic yards of grout, whichever occurs first; with one prism compression tested at 7-days, one at 28-days, and one held in reserve. There shall be a minimum of three (3) grout prism cast, in addition to the initial five (5), for the project. The prisms shall be delivered to the Testing Agency within 24 hours of placement. Provide an additional set of five (5) prisms for each change in mix proportions, mix methods, or materials.

3. The Contractor will ensure that masonry received on-site meets the requirements of the Project Specifications. Mortar is not allowed to be placed if it is more than 1 hour old from the time of initial mixing. The Inspector will oversee the mixing and delivering operations to ensure that the Contractor is producing masonry as specified and may request additional tests to ensure that quality masonry is being produced. Results of these inspections will be recorded in the Contractor's Daily Construction Report.

The above noted verification and testing program is not intended to replace the project specification requirements as they apply to material testing requirements. Where duplication or similar tests are required the more comprehensive/stringent testing procedure shall be required.

Codes: Comply with the applicable requirements of governing authorities and codes for the types of masonry construction shown.

B. Fire Resistance: Where fire-resistance ratings are indicated or required by authorities having jurisdiction, provide materials and construction which is identical to assemblies whose fire-resistance rating has been tested in compliance with ASTM E119 and authorities having jurisdiction.

C. Coordination: Review installation procedures and coordinate with work that must be integrated with masonry.

D. Construction Tolerances: Lay up all wall and partitions plumb and true with courses level and accurately spaced and coordinated with other work. Variations from plumb, true or level of more than 1/8 inch in 10 feet 0 inches in any direction are unacceptable.

E. Job Mock-up: prior to installation of masonry work, erect sample wall panel mock-up using materials, bond and joint tooling shown or specified for final work. Build mock-up at the site, where directed, of full thickness and approximately 4 feet x 3 feet, unless otherwise shown, indicating the proposed range of color, texture and workmanship to be expected in the completed work. Obtain Architect's acceptance of visual qualities of the mock-up before start of masonry work. Retain mock-up during construction as a standard for judging completed masonry work. Do not alter, move or destroy mock-up until work is completed – mock-up may become part of Final Work.

F. Provide adequate bracing of walls during erection to prevent damage due to high winds or other lateral loads until permanent bracing is installed. Contractor shall assume all responsibility for damage due to failure to take such precautions.

1.5 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's data for concrete masonry units required, including certified copies of laboratory test reports and other data as may be required to show compliance with the specified requirements.

B. Samples: Submit samples of each type of masonry unit specified. Select units to show the range of color and texture which can be expected in the finished work.

1.6 JOB CONDITIONS

A. Masonry Protections:
1. Protect masonry materials during storage and construction from wetting by rain, snow or ground water and from soilage or intermixture with earth or other materials.
2. In exposed work, do not use masonry units with chips, cracks, voids, discolorations or other defects, which might be visible or cause staining in finished work.
3. Protect partially completed masonry against weather, when work is not in progress, by covering top of walls with strong, waterproof, non staining membrane.
4. Protect masonry from freezing when the temperature of the surrounding air is 40 degrees F. and falling. Heat materials and provide temporary protection of completed portions of masonry work. Comply with governing codes and NCMA TEK 16 recommendations for cold weather concrete masonry construction.
5. Frozen Materials: Do not use frozen materials or materials mixed or coated with ice or frost.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Units: Hollow load-bearing, ASTM C90, Type 1, Grade N. Aggregate shall conform with ASTM C-33.
1. Size: Manufacturer's standard units with nominal face dimensions of 16 inches long x 8 inches high. Provide thicknesses indicated on the drawings.
2. Special Shapes: Provide special shaped units for lintels, corners, jambs, headers, control joints and other conditions. Never expose cores.
3. Color/Finish: Provide manufacturers standard units suitable for field applied paint finish unless otherwise noted on the drawings.

2.2 MORTAR & GROUT MATERIALS

A. Portland Cement: ASTM C150 86, Type I, non staining, without air entrainment and of natural color or white to produce the required color of mortar or grout.
1. Use Type III high early strength as required for laying masonry in cold weather.

B. Hydrated Lime: ASTM C207, Type S.

C. Aggregates: ASTM C144.

D. Water: Clean, free of deleterious materials, which would impair strength or bond.

E. Mortar Mix:
1. Type S for reinforced and load bearing masonry; ASTM C270
2. Type N for masonry above grade and interior work.
3. Type M for masonry below grade and in contact with earth.

F. Grout for Masonry Fill: Portland cement, sand, gravel and water, proportioned as required to provide a 28-day minimum compressive strength of 3000 psi.

2.3 REINFORCEMENT, TIES & ANCHORS

A. Horizontal Joint Reinforcement: Provide galvanized ladder or truss type reinforcement for single Wythe masonry equal to Durowal "Standard" types unless otherwise noted.
   1. Wire: 9 (nine) gauge side and cross rods hot dip galvanized in conformance with ASTM A153, Class B2, 1.5 oz. per sq. ft.
   2. Corners and Intersections: Provide prefabricated corners and tees.
   3. Width: Provide one side rod for each concrete masonry shell face. Provide width as recommended by manufacturer for wall width and which gives at least 5/8" minimum cover on exterior walls.

B. Reinforcing Steel: Provide deformed rebars complying with ASTM A615, Grade 60.

2.4 ISOLATION CONTROL GASKETS

A. Gaskets: Closed cell neoprene conforming to ASTM C 509 equal to "Everlastic Neoprene" Type NN as manufactured by William Products, Inc.

PART 3 - EXECUTION

3.1 CONDITION OF SUBSTRATE

A. Examine the areas and conditions under which unit masonry work is to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Do not wet concrete masonry units.

3.3 INSTALLATION, GENERAL

A. Thickness: Build single wythe walls to the actual thickness of the masonry units, using units of nominal thickness shown or specified.

B. Cut masonry units using motor driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide pattern shown and to fit adjoining work neatly. Use full size units without cutting wherever possible.

3.4 LAYING MASONRY WALLS

A. General:
   1. Do not use mortar or grout which has begun to set or if more than 2-1/2 hours have elapsed since initial mixing. Re-temper mortar during the 2-1/2 hour period only as required to restore workability.
   2. Layout walls in advance for accurate spacing of surface bond patterns with uniform joint widths and to properly locate openings, movement type joints, returns and offsets. Avoid the use of less than half size units at corners, jambs and wherever possible at other locations.
   3. Lay up walls plumb and true to comply with specified tolerances, with courses level, accurately spaced and coordinated with other work.
   4. Pattern Bond: Lay concrete masonry units in running bond with vertical joint in each course centered on units in courses above and below, unless otherwise shown on the drawings.

B. Mortar Bedding and Jointing:

1. Lay hollow concrete masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course on floor slabs and where adjacent to cells or cavities to be reinforced or filled with concrete or grout.
2. Joint Width: Lay masonry with 3/8-inch wide joints, unless otherwise indicated.
3. Lay solid masonry units with completely filled bed and head joint; butter ends with sufficient mortar to fill head joints and shove into place. Do not slush head joints.
4. Tool exposed joints slightly concave unless otherwise shown. Compress mortar to form a dense, smooth, water tight surface.
5. Remove masonry units disturbed after laying; clean and reset in fresh mortar. If adjustments are required, remove units, clean off mortar and reset in fresh mortar.

C. Stooping and Resuming Work: Rake back 1/2 block length in each course; do not tooth. Clean exposed surfaces of set masonry and remove loose masonry units and mortar prior to laying fresh masonry.

D. Grouting: Grout cells of masonry units where shown and at all masonry lintels, bond beams, jambs and bearing points. Fully grout concrete masonry for three full courses below bearing points. Fully grout metal frames built into masonry work. Fully grout cells of masonry units, which contain vertical reinforcing bars.
1. Pour grout using container with spout and consolidate immediately by rodding or puddling; do not use trowels. Place grout continuously; do not interrupt pouring of grout for more than one hour. Terminate pour 1 1/2 inches below top of highest course in pour.

E. Expansion Joints: Provide expansion, and isolation joints in masonry where shown. Build in related items as the masonry work progresses. Rake out mortar in preparation for application of caulking and sealants. See "Sealants and Caulking" section.
1. If expansion joints are not shown, provide joints 30 feet o.c. throughout the work.
2. For non load bearing work allow for deflection between top of walls and structure above. Maintain lateral stability with concealed clip angles attached to structure above in a manner acceptable to Architect. Provide compressible fillers and joint sealers to maintain acoustical performance of wall assembly.

3.5 REINFORCEMENT, TIES AND ANCHOR INSTALLATION

A. Horizontal Joint Reinforcing: Provide continuous horizontal joint reinforcing as shown and specified. Fully embed longitudinal side rods in mortar for their entire length with a minimum cover of 5/8 inch on side of walls. Lap reinforcement a minimum of 6 inches at ends of units.
1. Reinforce all single Wythe or multi wythe walls with continuous horizontal joint reinforcing not more than 16 inches on center vertically unless otherwise shown.
2. Space reinforcing at 8 inches o.c. above and below openings and extend reinforcing at least 2 feet beyond each jamb.

B. Reinforced Concrete Masonry: Reinforce concrete masonry units where shown on the drawing with #4 rebars at 16 inches o.c. unless otherwise noted. Provide horizontal joint reinforcing as stated above.

3.6 LINTEL INSTALLATION

A. Metal Lintels: Install loose metal lintels where shown on the Drawings.

B. Masonry Lintels: Provide masonry lintels where indicated and wherever openings are shown without another type of lintel. Provide precast, preformed or built in place lintels which are adequate for loading conditions encountered. Provide at least 8 inches of bearing at each end. Obtain Architect's approval of all masonry lintels used.

3.7 REPAIR, POINTING AND CLEANING

A. Remove and replace masonry units which are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge any voids or holes, and completely fill with mortar. Point up all joints at corners, openings and adjacent work to provide a neat, uniform appearance, properly prepared for application of caulking or sealant compounds.

C. Cleaning Exposed, Unglazed Masonry Surfaces:
   1. Wipe off excess mortar as the work progresses. Dry brush at the end of each day's work.
   2. Final Cleaning: After mortar is thoroughly set and cured, clean sample wall area of approximately 20 sq. ft. as follows. Obtain Architect's acceptance of sample cleaning before proceeding to clean rest of masonry work.
      a. Dry Clean to remove large particles of mortar using wood paddles and scrappers. Use chisel or wire brush if required.
      b. Presoak wall before saturating with water and flush off loose mortar and dirt.
      c. Scrub down wall with stiff fiber brush and a solution of 1/2 cup of trisodium phosphate and 1/2 cup of household detergent dissolved in one gallon of water.
      d. Rinse walls, using clean, pressurized water, to neutralize cleaning solution and remove loose material.
      e. Acid cleaning of masonry will not be permitted.

3.8 PROTECTION

A. Protect the masonry work from deterioration, discoloration or damage during subsequent construction operations.

B. Normal weathering of masonry work, exposed to the weather after completion, will be acceptable, provided other conditions and activities do not interfere and result in an unacceptable condition.

END OF SECTION

SECTION 05120

STRUCTURAL STEEL

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The extent of structural steel work is shown on the drawings.

1. Structural steel is that work defined in the AISC "Code of Standard Practice" and as otherwise shown on the drawings.

B. Related Work Specified Elsewhere:

1. Section 03330 - Cast-in-Place Concrete
2. Section 03410 - Structural Precast Concrete
3. Section 04200 - Unit Masonry
4. Section 05300 - Metal Decking
5. Section 05500 - Miscellaneous Metals

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Elevator Hoist Beam
2. Stair Enclosure Framing
3. Barrier Cable Supports
4. Bas-relief Panel Supports
5. Steel lintels

1.3 QUALITY ASSURANCE

A. Codes and Standards: Comply with the provisions of the following codes and standards except as otherwise indicated:

1. AISC "Code of Standard Practice for Steel Buildings and Bridges".

2. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings" and including the "Commentary" and supplements thereto as issued.

3. AISC "Specifications for Structural Joints using ASTM A325 OR A490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.

4. AWS D1.1 "Structural Welding Code".

5. ASTM A6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use".

B. Qualifications:

1. Qualify welding processes and welding operators in accordance with AWS D1.1.

2. Provide certification that welders to be employed in the work have satisfactorily passed AWS

qualification tests within the previous 12 months.

3. All welders working on this project will be assigned an identifying symbol or mark. Each welder will be required to mark or stamp his symbol on each weldment completed for identification. Contractor shall maintain a record of welders employed, date of qualification and symbol or identification mark assigned to each.

4. Steel Fabricator: Fabricator shall have not less than five (5) years experience in the fabrication of structural steel. Submit a written description of fabrication ability including fabricating and surface preparation facilities, personnel and list of similar completed projects.

5. Steel Erector: Erector shall have not less than five (5) years experience in the erection of structural steel. Submit a written description of structural steel erection ability including equipment, personnel and a list of similar completed projects.

C. Source Quality Control:

1. Materials and fabrication procedures are subject to inspection and tests in the mill, shop, and field by the Architect. Such inspections and tests will not relieve the Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

D. Design of Members and Connections:

1. All details shown are typical, similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at the site whenever possible without causing delay in the work.

2. Promptly notify the Architect whenever design of members and connections for any portion of the structure are not clearly indicated.

E. Steel Testing: Materials and installed work may require testing and retesting, as directed by the Architect, at any time during the progress of the work. Allow free access to material stockpiles and facilities at all times. Tests, not specifically indicated to be done at the Owner's expense, including the retesting of rejected materials and installed work, shall be done at the Contractor's expense.

1.4 SUBMITTALS

A. Manufacturer's Data:

1. Submit five (5) copies of producer's or manufacturer's specifications and installation instructions for the following products. Include laboratory test reports and other data as required to show compliance with these specifications.

a. Structural steel (each type), including certified copies of mill reports covering the chemical and physical properties.

b. High-strength bolts (each type), including nuts and washers.

c. Unfinished bolts and nuts.

d. Paint products.

e. Shrinkage-resistant grout.

f. Description of each type of welding stud and arc shield.

B. Shop Drawings:

1. Submit shop drawings including complete details and schedules for fabrication and shop assembly of members, and details, schedules, procedures and diagrams showing the sequence

of erection.

2. Review of shop drawings will be for general considerations only. Compliance with requirements for materials fabrication and erection of structural steel is the Contractor's responsibility.

   a. Include details of cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols, and show size, length, and type of each weld.

   b. Provide setting drawings, templates, and directions for the installation of anchor bolts and other anchorages to be installed by others.

   c. Shop drawings shall include complete details of the painting work to be performed.

C. Erection Procedure: Submit data, illustrative and written to describe the structural steel erection procedure, including the sequence of erection and temporary staying and bracing. Contractor shall provide sufficient bracing, etc. so that the erected steel is stable during construction or until all the concrete slabs are poured.

D. Welding Procedure and Equipment:

1. Submit written description as required to illustrate each welding procedure to be performed in the specified work.

2. Submit descriptive data for field welding equipment, including type, voltage and amperage.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site at such intervals to insure uninterrupted progress of the work.

1. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time to not delay that work.

B. Store materials to permit easy access for inspection and identification. Keep steel members off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.

1. Do not store materials on the structure in a manner that might cause distortion or damage to the members of the supporting structures. Repair or replace damaged materials or structures as directed.

C. Handling, shipping, and erecting of painted steel shall not be performed until thoroughly dry. Special care shall be exercised to avoid abrasion or other damage to the coated surfaces. Stacking and storing of painted members in the shop, in transit, and at the job site shall be done using softeners and timbers to keep individual members free from contact with the ground, and with each other; and shall be protected from soiling by adjacent fabrication of construction operations.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. Steel Base Plates: ASTM A36, Grade 36, except where other type steel is shown.

B. Structural Steel Beams, Columns, and Cross Bracing Members, Low Alloy Steel: ASTM A572 Grade 50 or 50W.

C. Cold-Formed Steel Tubing: ASTM A500, Grade B, Fy 46 ksi.

D. Steel Pipe: ASTM A53, Type E or S, Grade B, double extra strong.

E. Carbon Steel Castings: ASTM A27, Grade 65-35, medium-strength carbon steel.

F. Anchor Bolts: ASTM A307, nonheaded type unless otherwise indicated.

G. Headed Stud Type Shear Connectors: ASTM A108, Grade 1015 or 1020, cold finished carbon steel; with dimensions complying with AISC Specifications.

1. Studs shall be end welded, spacing as per drawings or the number of studs per beam length to be uniformly distributed in a zigzag pattern along the length of the beam.

2. Mechanical properties of finished studs, ASTM A370, shall be:

a. Minimum tensile strength, 60,000 psi.
b. Minimum yield strength, 50,000 psi (2% offset).
c. Minimum elongation, 20% in 2 inches.
d. Minimum reduction in area, 50%.

H. High-Strength Bolts and Nuts: Heavy hexagonal structural bolts, heavy hexagon nuts, and hardened washers, all galvanized and complying with ASTM A325.

I. Electrodes for Welding: Comply with AWS Code.

J. Filler Material for Welding:

1. Shielded metal-arc welding AWS A5.1

2. Welded joints designed using E7018 low hydrogen electrodes.

3. Fabricator or Erector may substitute filler material in accordance with Section 1.17.2 of AISC Specification for Structural Steel for Buildings after obtaining Architect's approval.

K. Metallic Non-Shrink Grout: Corps of Engineers CRD-C588, Type M, pre-mixed factory-packaged ferrous aggregate grouting compound.

1. Products offered by manufacturers to comply with the requirements include the following:

a. MasterFlow; Master Builders.
b. Sonogrout; Sonneborn.
c. SikaGrout; Sika.
d. Construction Grout; W.R. Grace.

L. The coatings materials specified are products of the Tnemec Company. Equal products by Koppers, Dupont or an approved equal will be considered for approval if submitted with a copy of data sheets that include performance criteria of the proposed coating and color charts. Minimum dry film thickness herein specified shall hold precedence over whatever recommendations are made for other supplier's products. Colors shall be as selected by the Architect.

M. The coatings system shall consist of the following: NOTE COORDINATE WITH SECTION 09900.

1. Shop Applied Primer: No. 90-97
Tneme-Zinc at 2.0 to 4.0 mils
dry film thickness.

2. Shop Applied Topcoat: No. 73
Endurashield III at 3.5 to 5.0 mils
dry film thickness.

3. Field Touch-up: No. 50-330

Poly-ura-primer at 2.0 to 4.0 mils
dry film thickness

N. The manufacturer's printed label instructions for all handling, applying, and re-coat intervals for the coatings system shall be followed. No work shall be performed when temperature and humidity conditions are outside the limitations stated by the coatings manufacturer.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. The Owner shall employ an approved testing laboratory to perform field quality control testing.

B. Provide access for the Architect to places where structural steel work is being fabricated or produced.

C. The Architect reserves the right, at any time before final acceptance, to reject material not complying with specified requirements.

D. Correct deficiencies in structural steel work, which inspections and laboratory test reports have indicated to be not in compliance with requirements. Perform additional tests as may be necessary to reconfirm any non-compliance of the original work, and as may be necessary to show compliance of corrected work.

E. All certificates and reports as specified shall be submitted to the Architect. A Testing Agency shall be employed by the Owner for the tests specified below, and for other tests as may be required.

F. The Testing Agency shall perform the following tests:

1. Shop Welding: Inspect and test during fabrication of structural steel assemblies, as follows:

a. Certify welders and conduct inspections and tests as required. Record types and locations of all defects found in the work. Record work required and performed to correct deficiencies.

b. Perform visual inspection of all welds.

c. Perform tests of welds as follows:

* Magnetic Particle Inspection: ASTM E109; performed on the root pass and on the finished weld. Cracks or zones of incomplete fusion or penetration not acceptable.

* Radiographic Inspection: ASTM E94 and ASTM E142; minimum quality level "2-2T".

* Ultrasonic Inspection: ASTM E164.

2. Field Bolted Connections: Inspect in accordance with AISC specifications.

3. Field Welding: Inspect and test during erection of structural steel as follows:

a. Certify welders and conduct inspections and tests as required. Record types and locations of defects found in the work. Record work required and performed to correct deficiencies.

b. Perform visual inspection of all welds.

c. Perform tests of welds as follows:

* Magnetic Particle Inspection: ASTM E109; performed on the root pass and on the

finished weld. Cracks or zones of incomplete fusion or penetration not acceptable.

* Radiographic Inspection: ASTM E94 and ASTM E142 minimum quality level "2-2T".

4. Determine mechanical properties, in accordance with ASTM A370, of the following materials:

   a. Anchor bolts.

   b. Filler metals for welding.

5. Inspection of Shop Painting:

   a. Surface preparation prior to painting shall be visually evaluated for degree of cleaning by comparison with SSPC pictorial standards Vis-1.

6. Testing laboratory shall report test results in writing to the Architect on the same day that tests are made. The reports shall contain the project identification name and number, date, name of Contractor, name of material supplier, name of testing service, type and class of steel, location of test in the structure, and type and results of tests taken.

G. Defective Work: Steel work, which does not conform to the specified requirements, including strength, tolerances, and finishes, shall be corrected at the Contractor's expense. The Contractor shall also be responsible for the cost of corrections to any work affected by or resulting from corrections to the steel work, including but not limited to any additional testing as may be required when unacceptable steel work is suspected and verified.

3.2 FABRICATION

A. Shop Fabrication and Assembly:

1. Fabricate and assemble structural assemblies in the shop to the greatest extent possible. Fabricate items of structural steel in accordance with the governing specifications and as indicated on the final shop drawings. Provide camber in structural members as shown, and fabricate so that the natural camber of the beams is turned upward.

2. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence, which will expedite erection and minimize field handling of materials.

3. Where finishing is required, complete the assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in the final structure free of markings, burrs, and other defects.

4. Fabricate Structural Steel in accordance with the latest AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings.

B. Connections:

1. Weld or bolt shop connections, as indicated. Contractor to provide all design calculations for these connections.

2. Bolt field connections, except where welded connections or other connections are indicated.

   a. Provide high-strength threaded fasteners for all principal bolted connections, except where otherwise shown.

3. High-Strength Bolted Construction: Install high-strength threaded fasteners in accordance with

AISC "Specifications for Structural Joints using ASTM A325 or A490 Bolts".

a. All high strength bolts shall be tightened by standard impact wrench using the turn-of-the-nut method.

b. Other tightening methods, conforming to specifications for structural steel joints may be used only with approval of the Architect.

4. Welded Construction: Comply with AWS Code for procedures, appearance and quality of welds, and methods used in correcting welding work.

   a. Assemble and weld built-up sections by methods which will produce true alignment of axes without warp.

5. Shear Connectors: Prepare steel surfaces as recommended by the manufacturer of the shear connectors.

   a. Provide headed stud type shear connectors welded to beams, girders, and other areas as detailed. Spacing as indicated on the drawings or, if not so indicated, studs to be uniformly spaced in a zigzag pattern along the length of the member.

   b. Headed type shear connectors shall be automatically end welded in accordance with Article 431 and 432 of AWS Building Code.

6. Bearing Plates:

   a. Bearing plates shall be provided under beams and girders resting on footings, piers and walls.

   b. Bearing plates shall be either loose or attached.

7. Base Plates:

   a. Column base plates shall be rolled, pressed and milled as per AISC Specification, Sect. 1.21.3 and furnished attached to the column.

C. Holes for Other Work:

1. Provide holes required for securing other work to structural steel framing, and for the passage of other work through steel framing members, as shown on the final shop drawings. Provide threaded nuts welded to framing, and other specialty items as shown to receive other work.

2. Cut, drill or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

3.3 SURFACE PREPARATION AND PAINTING

A. It is intended that the primer and finish coats of the protective coatings system be applied in the shop. Provisions shall be made for proper handling at all stages of the painting, shipping, storing at the job site, and erecting that will protect coated surfaces from damage or soiling.

B. Surface Preparation:

1. All steel shall be cleaned in accordance with Steel Structures Painting Council SP-6; Commercial Blast Cleaning.

2. Surface profile shall not exceed 1.5 mils.

3. Cleaning shall be done after fabrication and no more than six (6) hours prior to shop painting.

C. Shop paint all structural steel work, except those members or portions of members to be embedded in concrete or mortar. Paint embedded steel, which is partially exposed on the exposed portions and the initial 2" of embedded areas only.

D. Painting:

1. Immediately after surface preparation, apply structural steel primer paint in accordance with the manufacturer's instructions. Use painting methods, which will result in full coverage of joints, corners, edges and all exposed surfaces.

2. Application shall be by spray to thoroughly cleaned surfaces only, in accordance with all provisions of SSPC PA-1 Paint Application, with specified dry film thicknesses maintained on edges and corners. Sharp cut edges shall be uniformly relieved to form a slight radius sufficient to permit proper wrap of the coatings.

E. Surfaces inaccessible to blast cleaning after assembly shall be blast cleaned and coated beforehand. Paint faying surfaces of high strength bolted friction connections as permitted by AISC Manual of Construction for the specified primer.

F. A pre-production conference shall be arranged by the Contractor with the Architect, the Fabricator and a representative of the paint manufacturer in attendance, to discuss all details relevant to performing the work in accordance with the requirements.

G. Mock-up shall be produced on a sample piece or section, for approval before production.

H. Touch-up after erection shall consist of smoothing all damaged painted areas, and building back each coat to achieve initial condition. Where abraded to bare metal, and all other bare surfaces such as on field welds, bolts, washers and nuts - the surfaces shall be cleaned to the standard of the shop applied system and painted with the two coat system, in proper re-coating intervals.

3.4 INSPECTION

A. Examine the areas and conditions under which structural steel work is to be installed. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.

3.5 ERECTION

A. General: Comply with the governing Specifications and as herein specified.

B. Employ a Professional Engineer, registered in the jurisdiction where the work is performed, to supervise surveys during erection as follows:

1. Check elevations of bearing surfaces.

2. Check locations of anchor bolts.

3. Ensure accuracy of erection within specified tolerances.

4. Individual pieces shall be erected so that deviation from plumb, level and alignment shall not exceed 1 to 500.

C. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections

of sufficient strength to bear imposed loads. Remove temporary members and connections when permanent members are in place and final connections are made.

D. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete the work. Comply with all City, State, and OSHA regulations as required.

E. Anchor Bolts: Furnish anchor bolts and other connectors required for securing structural steel to foundations and other in-place work.

1. Furnish templates and other devices as necessary for presetting bolts and other anchors to accurate locations.

a. Refer to Division 3 of these specifications for anchor bolt installation requirements in concrete, and Division 4 for masonry installation.

F. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean the bottom surface of base and bearing plates.

1. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.

2. Tighten the anchor bolts after the supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with the edge of the base or bearing plate prior to packing with grout.

3. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure in strict compliance with the manufacturer's instructions, or as otherwise required.

G. Field Assembly: Set structural frames accurately to the lines and elevations indicated. Align and adjust the various members forming a part of a complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces, which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of the structure within specified AISC tolerances.

2. Fastening of splices of compression members shall be done after the abutting surfaces have been brought completely into contact.

3. Splices shall be permitted only where indicated.

4. Field connections, including high strength bolted construction, welded construction and shear connectors shall be as specified under "Fabrication".

H. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces.

I. Comply with AISC Specifications for bearing, adequacy of temporary connections, alignment, and the removal of paint on surfaces adjacent to field welds.

1. Do not enlarge unfair holes in members by burning or by the use of drift pins, except in secondary bracing members. Ream holes that must be enlarged to admit bolts.

J. Gas Cutting: Do not use gas-cutting torches in the field for correcting fabrication errors in the

structural framing. Cutting will be permitted only on secondary members, which are not under stress, as acceptable to the Architect. Finish gas-cut sections equal to a sheared appearance when permitted.

END OF SECTION

SECTION 05216

PRESTRESSED BARRIER CABLE GUARD SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. The extent of work included in this Section is shown on the Drawings and is specified as follows:
   1. Prestressed barrier cable assemblies for vehicular guards and pedestrian guards at the south façade.

B. The work includes furnishing and installing an engineered barrier cable guard system consisting of prestressed seven-wire steel strands and complete with all related sleeves, supports and anchors, jacks and jacking, distribution plates, spacer bars, accessories, devices, etc.

C. The work also consists of furnishing all labor, material, and equipment necessary for completion of the following work:
   1. Furnish and install all system materials intended for use in aggressive environments.
   2. Perform all prestressing operations, including but, not limited to stressing, backstressing and anchoring tendons.
   3. Keep records of stressing operations.
   4. Terminating tendon ends (after Architect's review) and patching stressing pockets (as applicable).
   5. See Structural Drawings for additional general notes applying to work under this section. In case of discrepancy between the Specifications and the Drawings, the most stringent will govern as determined by the Architect.

1.2 DEFINITIONS

A. Barrier Cable: A steel prestressing strand meeting the requirements of this Specification. Barrier cables may interchangeably be referred to as either "cables", "tendons" or "strands".

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design Prestressed Barrier Cable Guard Systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated and in compliance with the design intent as indicated in the Contract Documents.
   1. Employ a professional engineer, registered in the state where the project is located, to perform design. Professional Engineer shall sign and seal Shop Drawings and Calculations submitted for review.

B. Structural Performance: All guard assemblies, including cables, anchors and connections, shall withstand the effects of gravity loads and the following loads within limits and under conditions indicated in the Structural General Notes and on the Drawings:
   1. Pedestrian Guard Loads: See Section 055100 – Metal Stairs and Railings.
   2. Vehicular Guard Loads:
      a. Pedestrian guard loads are applicable to all vehicle barrier systems and are not required to act concurrently with loads applicable to those systems.
      b. Vehicle Barrier Systems for Passenger Vehicles:
         1) The loading selected must be that producing a more unfavorable effect of the following:

a) Article 4.5.3. of ASCE 7-10, “Minimum loads for Buildings and other Structures”.
b) Local governing building code.

1.4 SUBMITTALS

A. Manufacturer’s Data: Submit manufacturer's product data, specifications, anchor details and installation instructions for products to be used in the fabrication of guard assemblies, including painting products and patching materials.

B. Samples: Submit one (1) sample of all Prestressed Barrier Cable Guard System materials.

C. Shop Drawings: Submit shop drawings for fabrication and erection of guard assemblies. Include plans, elevations, and details of sections and connections. Show anchorage and accessory items. Provide templates for anchor bolt installation. All shop drawings shall be signed and sealed by a professional engineer, registered in the state where the project is located.
   1. Shop Drawings shall include, but not be limited to, the following information:
      a. Tendon layout and dimensions locating tendons.
      b. Final effective forces of each tendon. Type and description of a method to ascertain that this force has been achieved.
      c. Details, location and arrangement of tendon dead end and stressing end anchorage devices. These details shall be thoroughly coordinated with the placement of the corresponding column and beam reinforcement to ascertain ability to install anchorages without interference with other components within the supporting structure or the joints between structural support members.
      d. Details and/or description of procedure ascertaining proper field connection between the cable and anchor as per the system manufacturer’s requirements.

D. Calculations: Submit calculations as follows for review and acceptance by the Engineer of Record (EOR) along with the shop drawings for each portion of the work. All calculations shall be signed and sealed by a professional engineer, registered in the state where the project is located.
   1. Calculations of anticipated elongations based on the required effective prestress for each type of cable and anchor. When seating loss is not available, use 3/8" for a wedge based anchorage.
   2. Calculations of bearing stress applied to the structure by the proposed anchoring device and engineering opinion on the adequacy of the structural component to carry this bearing stress.

E. Test Results and Certifications: Submit the following for review and acceptance by the Architect not less than three weeks prior to commencement of work:
   1. Mill Tests: Results of certified mill tests (including typical stress-strain curve) for each production lot from which project material will be taken. Such results shall include guaranteed ultimate tensile strength, yield strength, elongation, cross-sectional area and modulus of elasticity of the material tested.
   2. Equipment Calibration Tests: Results of certified calibration tests made within the last three months by an independent testing agency of all stressing equipment to be used on the project. Stressing equipment shall be calibrated as a unit especially when consisting of jack, gage, and pump. Components of calibrated units may not be interchanged during the course of the work without recalibration. Contractor shall submit method of identification of all stressing units. Calibration reports shall include a curve relating jack forces to gage readings. For other types of stressing equipment and/or anchoring systems, submit respective calibration tests relating gage readings to attained force.

F. Stressing Record: The Installer shall provide a stressing record for all tendons to the Architect. This record shall be in a form in conformance with recommendations of PTI and acceptable to the Architect, and include as a minimum for each tendon its mark, location and length, stressing unit identification, required and actual field gauge reading at each anchorage, and signatures of the pump/gage operator and the Testing Agency's representative witnessing the stressing operation.

G. Certifications: Provide certifications indicating compliance with the Quality Assurance article below.

1.5 QUALITY ASSURANCE

A. Codes and Standards
   1. Comply with requirements of the following codes and standards, latest edition, except as herein modified:
      a. American Society of Civil Engineers (ASCE)
         1) ASCE 7-10 – "Minimum Design Loads for Buildings and Other Structures".
      b. Post-Tensioning Institute (PTI)
         1) "Guide Specifications for Post-Tensioning Materials".
         2) "Specifications for Unbonded Single Strand Tendons".
         3) "Post-Tensioning Manual".
         4) "Field Procedures Manual for Unbonded Single Strand Tendons".
         5) "Specification for Seven-Wire Prestressing Steel Strand for Barrier Cable Applications".
      c. See Section 05 50 00 – Miscellaneous Metals for additional information pertaining to fabricated steel assemblies.
   2. In case of any discrepancy or conflicting requirements between codes and/or standards, the most stringent requirements will govern as determined by the Architect.

B. Installer Qualifications
   1. All stressing of tendons shall be under the immediate control of an Installer experienced in this type of work, who has successfully performed a minimum of five (5) previous installations similar to the one involved in this Contract. The Installer shall exercise close check and rigid control of all operations as necessary for full compliance with all contract requirements.
   2. Work shall be supervised by individuals experienced in post-tensioning construction. Qualifications of project supervisor(s) shall be included in bid submittal.

C. Inspection of Barrier Cable Placement and Stressing Operations
   1. An Independent Testing Agency will be retained by the Owner to observe and verify all post-tensioning work as specified this Section.

D. Personnel Required Onsite
   1. Contractor shall have supervisory personnel onsite at all times during tendon stressing operations.
   2. Installer shall have supervisory personnel onsite at all times during tendon placement, and stressing operations. Name and position of such supervisory personnel shall be provided to the Contractor and the Architect at the start of work but not later than seven (7) days prior to tensioning.
   3. The Testing Agency representative shall be onsite at all times during tendon layout, placement, and stressing operations. Stressing operations shall not proceed without a Testing Agency's representative present during operations.
   4. The Prestressed Barrier Cable Guard System Manufacturer shall supervise, as a minimum, the first occurrence of each stressing operation with subsequent monitoring as deemed necessary.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver guard systems and related components in protective packaging and store components to avoid damage from moisture, abrasion and other construction activities.

1.7 COORDINATION AND SCHEDULING

A. Coordinate installation of anchorages for guard systems. 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 in time for installation.

B. The prestressed barrier cable assemblies are solely intended to act as guards as prescribed by the performance requirements of this Section. No ancillary attachments shall be made to any prestressed barrier cable assemblies without prior approval by the Architect in writing.

1.8 INDEPENDENT TESTING AGENCY SERVICES

A. Independent Testing Agency's Services related to Prestressed Barrier Cable Guard Systems Work:
   1. The Testing Agency's Inspector shall observe the condition of tendons and anchorages in place prior to concreting (as applicable) and again prior to stressing. Any unsatisfactory condition of tendons or anchors must immediately be brought to the attention of the responsible supervisor, who must address said condition in a timely fashion to the satisfaction of the Testing Agency's Inspector, Any and all conditions not properly addressed by the Contractor prior to stressing, must be recorded and brought to the attention of the Architect in a most expedient way prior to stressing.
   2. The Testing Agency's Inspector shall review the contractors stressing and backstressing procedure, and witness the stressing operation and recording. In the event anchoring system for barrier cables does not require backstressing, verify proper connection of anchorage to cable.
   3. The Testing Agency's Inspector shall review the contractor's tendon terminating procedure and the condition of terminated tendons prior to grouting of pockets or installation of anchor end caps or corrosion-protective coating.
   4. Where fabricated steel items are utilized within Prestressed Barrier Cable Guard Systems and/or where the guard systems are attached to other building components by means of welding, bolting and/or drilled-in inserts, the Testing Agency shall perform inspection and tests as required within Division 1 specifications and the applicable Division 5 Sections.
   5. See Section Division 01 specifications for additional requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers offering systems of products complying with the requirements for Prestressed Barrier Cable Guard Systems include the following:
   1. AMSYSCO, Inc.
   2. DYWIDAG-Systems International USA Inc.
   3. Suncoast Post-Tension, Ltd.
   4. VStructural, LLC (VSL)
   5. Another manufacturer approved based on equivalent qualifications demonstrated by submitting information relative to record of successful projects of similar type and

complexity within the past 5 (five) years, participation in the industry and professional organizations, and at least 3 (three) positive client references.

2.2 MATERIALS

A. General: Provide cables, anchors, tensioning, grouting, etc. as indicated on the Drawings. All components are to be hot-dip galvanized. Comply with PTI "Specification for Seven-Wire Prestressing Steel Strand for Barrier Cable Applications".

B. Barrier Cables: Seven-wire steel strand, 0.5 in. diameter, galvanized per ASTM A475, Extra high Strength Grade, Class A with a minimum breaking strength of 26,500lbs. All strand to be manufactured by a single source.

C. Anchorages: All castings and machined barrel anchors shall comply with PTI requirements applicable to corrosive environments. Where specifically indicated on the Drawings, provide capped anchors with exterior thread and corresponding galvanized metal or otherwise corrosion resistant caps acceptable to the Architect.
   1. Wedges shall be designed to preclude premature failure of the barrier strand due to notch or pinching effects under test load conditions specified in Section 2.2.1.1 and 2.2.1.2 in PTI's "Specification for Unbonded Single Strand Tendons"

D. Related Steel Components and Fabrications: Where steel brackets and supports are indicated in the Drawings, these shall comply with the requirements of Section 055120 – Structural Steel.
   1. Finish: All related steel components and fabrications shall be factory primed and painted.

E. Manufacturer's standard corrosion resistant assembly components shall be hot dip galvanized and shall conform to ASTM A123 or ASTM A153, As applicable.

F. Sleeves: General Contractor to coordinate the provision of PVC pipe sleeves to accommodate cables passing through structural concrete items as indicated in the Drawings.

G. Grout Materials for Stressing Pockets (where specifically detailed only):
   1. Non-metallic Shrinkage-resistant Grout: Pre-mixed, non-metallic, non-corrosive, non-staining product containing selected silica sands, Portland Cement, shrinkage compensating agents, plasticizing, water reducing agents and corrosion inhibitors, complying with ASTM C 1107, grade B and Army Corps of Engineers CRD-C621. Subject to compliance with requirements, provide one of the following:
      a. "Euco NS" - The Euclid Chemical Co.
      b. "Crystex" - L & M Construction Chemicals.
      c. Masterflow 713" or Masterflow 928Plus" - Master Builders
      d. "Five Star Grout" - U.S. Grout Corp.
      e. Approved Equivalent.

H. When specifically directed by the Architect, adjust color of the pre-manufactured product by mixing it with trial-and-error selected quantity of white cement, to attain final cured color of the patch as close as possible to the surrounding concrete.

PART 3 - EXECUTION

3.1 EXAMINATION

A. {Retain option in paragraph below for electric operation.}

B. Examine substrates, structural support, sleeves, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

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

3.2 PREPARATION

A. Inserts and Anchorages: Furnish inserts and anchoring devices that must be set in concrete for installation of Cable Guard Systems.

3.3 INSTALLATION

A. Provide system as indicated on the Drawings installing cables in straight lines and at true heights.

B. Trim ends of PVC pipe sleeves flush with face of concrete. Patch spalling around PVC pipe sleeves as directed by the Architect.

C. Install fabricated anchorage, attachment and support items as shown in the final approved Shop Drawings.

D. Stressing Procedure for Cables
   1. Backstress and stress cables to seat wedges as shown on the Drawings. Follow PTI recommended procedures. Consult with Architect concerning stressing/backstressing against materials other than concrete.
   2. Wedges shall be seated at 80% minimum ultimate tensile strength (MUTS) of the strand.
   3. Coordinate jack placement and bracing as required to protect any structural members being attached to from damage during tensioning process.

E. Upon completion of the stressing and receiving the Architect's approval of the stressing record, terminate excess length of cable by an approved method and apply two coats of galvanizing compound and/or install manufacturer's screw-on cap tightly.

F. Final Disposition of Cable Anchors:
   1. For anchors left exposed in the final condition, provide approved caps or cover assemblies to completely conceal trimmed ends of cables, unless otherwise detailed on the Drawings.
   2. For anchors recessed in concrete construction, fill pockets with non-shrink grout for smooth, flush condition.

3.4 REPAIRS

A. Galvanized Coatings
   1. Field Repair: For field touch up of hot-dip galvanized components, repair using zinc rich coating or "cold galvanizing" compound. Provide factory mixed and prepared organic binder, zinc-rich paint specifically formulated for use on steel surfaces and for repair of hot dip galvanized steel. Minimum 95% by weight of dry film of "ultra-pure" zinc dust per ASTM D520 Type III. Provide a minimum dry film thickness of 8 mils.

END OF SECTION

SECTION 05300

METAL DECKING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The extent of metal deck work is shown on the drawings and is hereby defined to include closure strips and miscellaneous accessories required for a complete system. The following types of steel form deck are required:

1. Roof Deck North Stair Roof Enclosure & South Stair Roof Enclosure

A. Related Work Specified Elsewhere:

1. Section 03410 – Structural Precast Concrete
2. Section 05500 – Miscellaneous Metals

1.2 QUALITY ASSURANCE

A. Codes and Standards: Comply with provisions of the following codes and standards, except as otherwise indicated:

1. American Iron and Steel Institute (AISI), "Specification for the Design of Cold-Formed Steel Structural Members."
2. American Welding Society (AWS), D1.3 "Structural Welding Code - Sheet Steel."
3. Steel Deck Institute (SDI), "Design Manual for Composite Decks, Form Decks and Roof Decks."

B. Qualification of Field Welding: Use qualified welding processes and welding operators in accordance with "Welder Qualification" procedures of AWS.

C. Underwriters' Label: Provide metal floor deck units listed in Underwriters' Laboratories "Fire Resistance Directory", with each deck unit bearing the UL label and marking for specific system detailed.

D. FM Listing: Provide steel roof deck units that have been evaluated by Factory Mutual System and are listed in "Factory Mutual Approval Guide" for "Class I" fire-rated construction.

1.3 SUBMITTALS

A. Product data including manufacturer's specifications and installation instructions for each type of decking and accessories.

1. Provide test data for mechanical fasteners used in lieu of welding for fastening deck to supporting structures.

B. Shop drawings showing layout and types of deck units, anchorage details, and conditions requiring closure strips, supplementary framing, sump pans, cant strips, cut openings, special jointing, and other accessories.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Vulcraft Div., Nucor Corp.
2. Consolidated Systems, Inc.
3. H. H. Robertson Co.
4. Wheeling Corrugating Co.

2.2 MATERIALS

A. Steel for Painted Metal Deck Units: ASTM A 1008, Grade A, with a minimal yield stress of 33 KSI.

1. Paint: Manufacturer's baked-on, rust-inhibitive paint, for application to metal surfaces which have been chemically cleaned and phosphate chemical treated. All decking to be factory primed and field painted.

B. Miscellaneous Steel Shapes: ASTM A 36.

C. Shear Connectors: Headed stud type, ASTM A 108, Grade 1015 or 1020, cold-finished carbon steel, with dimensions complying with AISC specifications.

D. Sheet Metal Accessories: ASTM A 653, commercial quality, galvanized or painted to match steel deck finish.

E. Flexible Closure Strips: Manufacturer's standard vulcanized, closed-cell, synthetic rubber.

2.3 FABRICATION

A. General: Fabricate deck units in lengths to span three or more supports, unless otherwise shown; with flush, telescoped, or nested 2 inch laps at ends and interlocking or nested side laps, of metal thickness, depth, and width as shown.

B. Roof Decks: Comply with the depth and gage requirements, physical cross-sectional properties of the deck and design criteria shown on the Drawings and as follows:

1. Design the decking for the superimposed dead and live loads as indicated, on a simple span condition with a limiting deflection of L/240, steel stress of 0.60 FY.
2. Comply with other design criteria as indicated in metal decking notes and design criteria notes.
3. Provide cellular decking to prevent visibility of screws and attachments.
4. Provide deck gauges as required by calculation, but not less than 20 ga.

C. Metal Closure Strips: Fabricate metal closure strips for openings between decking and other construction, of not less than 0.045-inch min. (18 gage) sheet steel. Form to provide tight-fitting closures at open ends of cells or flutes and sides of decking. Finish to match decking finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install deck units and accessories in accordance with manufacturer's recommendations, shop drawings, and as specified herein.

B. Place deck units on supporting steel framework and adjust to final position with ends accurately aligned and bearing on supporting members before being permanently fastened. Do not stretch or contract side lap interlocks.

C. Place deck units flat and square, secured to adjacent framing without warp or deflection.

D. Coordinate and cooperate with structural steel erector in locating decking bundles to prevent overloading of structural members.

E. Do not use floor deck units for storage or working platforms until permanently secured.

3.2 FASTENING DECK UNITS

A. Fasten floor deck units to steel supporting members by nominal 5/8 inch puddle welds or elongated welds of equal strength, spaced not more than 12 inches o.c. with a minimum of two welds per unit at each support.

B. Tack weld or use self-tapping No. 8 or larger machine screws at 4 feet o.c. for fastening end closures.

C. Fasten roof deck units to steel supporting members by not less than 1/2 inch diameter puddle welds or elongated welds of equal strength, spaced not more than 12 inches at every support and at closer spacing where indicated. In addition, secure deck to each supporting member in ribs where side laps occur.

D. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.

   1. Use welding washers where recommended by deck manufacturer.

E. Mechanically fasten side laps of adjacent deck units between supports, at intervals not exceeding 36 inches o.c., using self-tapping No. 8 or larger machine screws.

F. Uplift Loading: Install and anchor roof deck units to resist gross uplift loading of 45 lbs. psf at eave overhang and 30 lbs. psf for other roof areas.

G. Cutting and Fitting: Cut and neatly fit deck units and accessories around other work projecting through or adjacent to the decking, as shown.

H. Reinforcement at Openings: Provide additional metal reinforcement and closure pieces as required for strength, continuity of decking, and support of other work shown.

I. Hanger Slots or Clips: Provide UL-approved punched hanger slots between cells or flutes of lower element where floor deck units are to receive hangers for support of ceiling construction, air ducts, diffusers, or lighting fixtures.

   1. Locate slots or clips at not more than 14 inches o.c. in both directions, not over 9 inches from walls at ends, and not more than 12 inches from walls at sides, unless otherwise indicated.

J. Roof Sump Pans: Place over openings provided in roof decking and weld to top decking surface. Space welds not more than 12 inches o.c. with at least one weld at each corner.

K. Shear Connectors: Weld shear connectors to supports through decking units in accordance with manufacturer's instructions. Do not weld shear connectors through two layers (lapped ends) of decking units. Weld only on clean, dry deck surfaces.

L. Closure Strips: Provide metal closure strips at open uncovered ends and edges of roof decking and in voids between decking and other construction. Weld into position to provide a complete decking installation.

M. Touch-Up Painting: After decking installation, wire brush, clean, and paint scarred areas, welds, and rust spots on top and bottom surfaces of decking units and supporting steel members.

1. Touch-up galvanized surfaces with galvanizing repair paint applied in accordance with manufacturer's instructions.

2. Touch-up painted surfaces with same type of shop paint used on adjacent surfaces.

END OF SECTION

SECTION 05500

MISCELLANEOUS METALS
(Filed Sub-Bids Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

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

1.2 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: G000; G001; A002, A101-5, A201-208, A301, A302, A401, A402, A501, A502, A701.

B. Sub-sub Bids are not required for this trade.

1.3 SCOPE OF WORK

A. This work shall consist of miscellaneous and ornamental items including the following:

1. Loose steel bearing and leveling plates, including bearing plates for steel rafters

2. Galvanized steel lintels

3. Steel stair and ramp railings, guardrails, handrails, subrails, and bracket supports (See Alternates).

4. Steel support angles for elevator door sills.

5. Cants in elevator hoistway made from sheet steel.

6. Miscellaneous steel framing and supports, at stairwells.

7. Aluminum entry canopy framing at northwest Entry/Stair.

8. Aluminum tube columns (See Alternates)

9. Seismic clips.

10. Bollards & accessories.

B. Requirements for materials, hot-dip galvanizing, and shop-applied primers are included with each item as applicable.

C. Related Work:

1. Section 05120 STRUCTURAL STEEL FRAMING for structural steel items.

2. Section 05521 PRESTRESSED BARRIER CABLE GUARD SYSTEM: for pretensioned cable railings.

3. Section 099000 PAINTING for field painting work of this section

4. Section 10240 METAL ARCHITECTURAL MESH for hanging mesh panels.

5. Section 14240 HYDRAULIC ELEVATORS for metal ladder and accessories.

1.4 GENERAL

A. The work of this Section includes, but is not limited to, metal fabrications, installation of listed items, and final product performance.

B. Examine existing surfaces and verify existing conditions. Determine acceptability of the proposed installation conditions. Verify dimensions as no extras will be allowed for inconsistency in dimensions.

C. Cleaning and preparation of existing surfaces to receive materials shall be the Contractor's responsibility. Prepare surfaces as specified hereinafter and as recommended by manufacturer of the material selected.

1.5 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design stairs and railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Railings: Provide railings capable of withstanding the effects of gravity loads and Code required loads and stresses within limits and under conditions indicated.

C. Seismic Performance: Provide metal stairs capable of withstanding the effects of earthquake motions determined according to Code.

1.6 QUALITY ASSURANCE

A. Delegated design: Design ladders and miscellaneous framing and supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. NAAMM Stair Standard: Comply with "Recommended Design Standards for Metal Stair Railings" in NAAMM AMP 510, "Metal Stairs Manual."

C. Welding: Qualify procedures and personnel according to the following:

1. AWSD1.1, “Structural Welding Code—Steel.”

2. AWSD1.3, “Structural Welding Code—Sheet Steel.

D. Metal Surfaces, General: provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

1.7 SUBMITTALS

A. Product data. For the following

1. Coatings and Paint products

2. Grout.

B. Shop Drawings: Submit fabrication and installation details for metal fabrications.

1. Include plans, elevations, section, and details. Show anchorage and accessory items.

2. Provide templates for anchors and bolts specified for installation under other Sections.

3. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified engineer, licensed in the jurisdiction where Project is located, responsible for their preparation.

C. Welding certificates.

1.8 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal items without field measurements. Coordinate such dimensions with trades responsible for connecting construction to ensure that actual dimensions correspond to established dimensions.

2. Provide allowance for trimming and fitting at site.

1.9 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. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section, in a timely manner.

PART 2 - PRODUCTS

2.1 FERROUS METALS

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

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M, sizes as indicated on the Drawings.

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: ASTM A 500, cold-formed steel tubing, sizes as indicated on the Drawings.

E. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads, sizes as indicated on the Drawings.

1. Provide Schedule 80 pipe for bollards.

F. Slotted Channel Framing: Cold-formed metal channels with continuous slot complying with MFMA-3.

2.2 FASTENERS

A. General: Unless otherwise indicated, provide Type 316 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.

B. Anchor Bolts: ASTM F 1554, Grade 36. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.

C. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M 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.

2. Plastic covers for bollards: as shown on the Drawings.

D. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Acceptable Manufacturers: Kwik-Bolt 3 by Hilti, Inc., TruBolt Wedge Anchor by ITW Red Head or Power-Stud by Powers Fasteners.

2.3 ALUMINUM STOCK

A. Alloy and temper recommended by manufacturer for use and finish indicated.

1. Extruded bars, profiles, and tubes: ASTM B 221.

2. Extruded structural pipe and tubes: ASTM B 429.

3. Structural profiles: ASTM B 308/B 308M.

4. Welding rods and bare electrodes: AWS A5.10/A5.10M.

B. Finish: anodized, brush aluminum.

2.4 ALUMINUM CANOPY

A. Aluminum protective cover, equal to Mitchell Metals, LLC framed canopy, with perimeter extruded gutter and extruded decking, in a roll-locked design with extruded cap and pan interlock forming a rigid structure.
B. Fasteners: 300 series stainless steel with neoprene washers. Rivets to be 3/16" aluminum. Decking fasteners to be long life coated steel with 300 series stainless steel cap and neoprene washer.
C. Supply full shop drawings.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

C. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.

D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.

1. Provide interior, field-applied paint with a VOC content of 250 g/L or less, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for exterior applications.

2.6 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. 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. 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.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

E. 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.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

2.7 STEEL TUBE RAILINGS

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads.

B. Welded Connections: Fabricate railings with 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.

C. Form changes in direction of railings as detailed on the Drawings.

D. Form simple and compound curves by bending members in 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.

E. Close exposed ends of railing members with prefabricated end fittings.

F. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.

G. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.8 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.

2.9 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches, unless otherwise indicated.

2.10 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from 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.

2.11 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

2.12 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.

2.13 STEEL PRIMERS AND FINISHES

A. Preparation for Shop Priming: 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) and Items Indicated to Receive Zinc-Rich Urethane Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

2. Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be field welded, embedded in concrete or masonry, unless otherwise indicated. Extend priming of partially embedded members to a depth of 2 inches.

3. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

4. Comply with SSPC-PA 2, "Measurement of Dry Coating Thickness with magnetic Gages."

B. Zinc-Rich Primer: Urethane zinc rich primer compatible with topcoat Specified in Section 099000 - PAINTS AND COATINGS. Provide primer with a VOC content of 420 g/L (2.8 lb/gal.) or less per OTC and HAPS COMPLIANT STANDARDS PER 2007 standards when calculated according to 40 CFR 59, Subpart D (EPA Method 24). Provide Tnemec Series 394 Perimerprime at 3.0 mils DFT or approved equal by DuPont or Carboline.

C. Hot-Dip Galvanizing: for all bollards, railings, guardrails (except spandrel guardrails, see below), and other steel indicated to be galvanized:

1. For steel exposed to the elements, weather or corrosive environments and other steel indicated to be galvanized, provide coating for iron and steel fabrications applied by the hot-dip process. Comply with ASTM A 123 for fabricated products and ASTM A 153 for hardware.

2. Basis of design: Duragalv, as manufactured by Duncan Galvanizing. .

3. Galvanize full assemblies after fabrication. Where size of assembly is too large for complete unit galvanizing, galvanize prior to frabrication in as large sections as possible with Architect's written approval.

4. Provide thickness of galvanizing specified in referenced standards. The galvanizing bath shall contain high grade zinc and other earthly materials. Fill vent holes and grind smooth after galvanizing.

5. Galvanizing shall exhibit a rugosity (smoothness) of less than 25 microns when measured by a profilometer, for elements that are less than 24 lbs. per running foot.

D. For guardrails at spandrels (see drawings and Alternates), provide hot-dip galvanizing and factory-applied high performance polyamide epoxy primer, aliphatic acrylic polyurethane topcoat and aliphatic acrylic UV resistant anti-graffit clear coat, equal to Colorgalv Plus, as manufactured by Duncan Galvanizing, www.duncangalvanizing.com.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. 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.

B. 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.

C. 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.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

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 INSTALLING STEEL TUBE RAILINGS

A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as shown on the drawings.

3.3 INSTALLING 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.

B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

3.4 INSTALLING 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, 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.

3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION

SECTION 07000

ROOFING AND FLASHING
(Filed Sub-Bids Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: G000; G001; A002, A101-5, A201-208, A301-A302, A401-A402, A501-A502, A701.

B. Sub-sub Bids are not required for this trade.

1.3 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. All Work of Section 07541 – POLYVINYL CHLORIDE MEMBRANE ROOFING

2. All Work of Section 07620 –FLASHING AND SHEET METAL

3. All Work of Section 07710 – ROOF SPECIALTIES

END OF SECTION

SECTION 07541

POLYVINYL CHLORIDE (PVC) MEMBRANE ROOFING
(Part of Work of Section 07000 - ROOFING AND FLASHING, Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: G000; G001; A002, A101-A105, A201-208, A301-A302, A401-402, A701.

B. Sub-sub Bids are not required for this trade.

1.3 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Adhered membrane-roofing system.

2. Adhered cover board.

3. Vapor retarder.

4. Substrate board.

5. Flashing for equipment mounted on roofing and roofing penetrations.

6. Wood blocking, nailers, curbs and blocking associated with roofing.

B. Items To Be Furnished Only: Not Applicable.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 03410 – STRUCTURAL PRECAST CONCRETE for substructure.

2. Section 05300 – METAL DECKING for roofing substrate in one section.

3. Section 05120 – STRUCTURAL STEEL FRAMING for substructure.

4. Section 07600 - FLASHING AND SHEET METAL for metal roof penetration flashings, flashings, and counter flashings.

5. Section 07730 - ROOF ACCESSORIES for fascia, rakes, gutters and downspouts.

6. Section 079200 - JOINT SEALANTS for sealants.

1.4 DEFINITIONS

A. Roofing Terminology: Refer to ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definition of terms related to roofing work in this Section.

1.5 PERFORMANCE REQUIREMENTS

A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7. Provide documentation that proposed roofing system design meets all applicable Massachusetts State Building Code requirements.

D. Flashings: Provide base flashings, perimeter flashings, detail flashings and component materials that comply with requirements and recommendations in FMG 1-49 Loss Prevention Data Sheet for Perimeter Flashings; FMG 1-29 Loss Prevention Data Sheet for Above Deck Roof Components; NRCA Roofing and Waterproofing Manual (Fourth Edition) for Construction Details and SMACNA Architectural Sheet Metal Manual (Fifth Edition) for Construction Details, as applicable.

E. Energy Performance: Provide roofing system with Solar Reflectance Index (SRI) not less than 78 when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.

1.6 SUBMITTALS

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

B. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.

C. Qualification Data: For Installer and manufacturer.

D. Maintenance Data: For roofing system to include in maintenance manuals.

E. Inspection Report: Copy of roofing system manufacturer's inspection report of completed roofing installation.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain components for roofing system from or approved by roofing system manufacturer.

B. Installer Qualifications: Contractor, Contractor's Superintendent and Foreman shall have at least five years experience successfully constructing single-ply thermoplastic roof systems similar to system specified in material, design and importance and with a record of successful in-service performance.

C. Pre-installation Conference: Conduct conference at Project site. Comply with requirements in Division 01. Review methods and procedures related to roofing system including, but not limited to, the following:

1. Meet with the Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing including installers of roof accessories and roof-mounted equipment.

2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.

3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.

4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.

5. Review structural loading limitations of roof deck during and after roofing.

6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.

7. Review governing regulations and requirements for insurance and certificates if applicable.

8. Review temporary protection requirements for roofing system during and after installation.

9. Review roof observation and repair procedures after roofing installation.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.9 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.10 WARRANTY

A. Roofing Contractor's Warranty: The roofing subcontractor shall supply Owner with a minimum two-year workmanship warranty for each roof. In the event any work related to the roofing, flashing, or metalwork is found to be defective within two years of substantial completion, the roofing contractor shall remove and replace such at no additional cost to the Owner. The roofing subcontractor's warranty obligation shall run directly to the Owner, and a copy the roofing signed warranty shall be sent to the roofing system's manufacturer.

1. The duration of the Roofing Contractor's two-year warranty shall run concurrent with the roofing system's manufacturer's 30-year warranty.

B. Roofing Systems Manufacturer's Warranty: The roofing manufacturer shall guarantee roof areas to be in a watertight condition, for a period of 30 years, from the date of final acceptance of the roofing system. The warranty shall be a 30-year no dollar limit (NDL), non-prorated total system labor and material warranty, for wind speeds up to 72 miles per hour. Total system warranty shall include all roofing materials, related components and accessories including, but not limited to the substrate board, vapor retarder, insulation board, cover board, roofing membrane, membrane flashings, fasteners, adhesives, metal roof copings, metal roof edges and termination metals and roof drain assemblies. The manufacturer shall repair defects in materials and workmanship as promptly after observation as weather and site conditions permit. All requirements in the fabrication and installation of the roofing system shall meet the requirements to uphold the 30 year warranty.

PART 2 - PRODUCTS

2.1 POLYVINYL CHLORIDE (PVC) ROOFING MEMBRANE

A. Fiberglass mat reinforced membrane with lacquer coating:

1. Products: Membrane shall conform to ASTM D4434 (latest version), "Standard for Polyvinyl Chloride Sheet Roofing". Classification: Type II, Grade 1. Basis of Design:

a. Sarnafil G410-20

2. Subject to compliance with requirements, equivalent products by the following manufacturers may be incorporated into the Work:

a. Durolast

b. Fibertite by Seaman Corp.

c. Flex MF/R 80 by Flex Roofing Systems

d. Everguard, by GAF.

3. Thickness: 80 mils. Include all requirements for obtaining a 30 year system warranty.

4. Exposed Face Color: White and or Gray / meeting LEED reflectance requirements. Pitched roof color to be from standard color options of 7 or more colors, with ribs.

5. Physical Properties:

a. Tensile Strength: ASTM D638, machine direction 1675 psi, cross direction 1625 psi

b. Elongation at Break: ASTM D638, machine direction 250, cross direction 220

c. Tearing Strength: ASTM D1004, 22

d. Water Absorption: ASTM D570 >1.7%

2.2 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.

1. Liquid-type auxiliary materials shall meet VOC limits of authorities having jurisdiction.

B. Sheet Flashing: Manufacturer's standard sheet flashing of same material, type, reinforcement, thickness, and color as sheet membrane.

C. Metal Flashings: Manufacturer’s standard sheet flashing of same material and color of sheet membrane adhered to metal sheet.

D. Bonding Adhesive: Manufacturer's standard bonding adhesive for membrane, and solvent- based bonding adhesive for base flashings.

E. Metal Termination Bars: Manufacturer's standard predrilled stainless steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

F. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening membrane to substrate, and acceptable to membrane roofing system manufacturer.

G. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, termination reglets, cover strips, and other accessories.

2.3 VAPOR RETARDER

A. Self-Adhering Sheet Vapor Retarder at 80 mils Roofing Areas: ASTM D 1970, minimum 40-mil-thick film laminated to layer of rubberized asphalt adhesive; maximum permeance rating of 0.1 perm; cold-applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor-retarder manufacturer.

2.4 ROOF INSULATION

A. General: Provide preformed roof insulation boards that comply with requirements and referenced standards, selected from manufacturer's standard sizes and as required to achieve R-30 over the roof area. See roof drawings for roof insulation conditions.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, felt or glass-fiber mat facer on both major surfaces.

1. Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Sarnatherm by Sika Sarnafil

b. FTR – value by Seaman Corp.

c. Duro-Guard ISO II by Durolast

d. ISO II by Flex

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

1. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.

2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.

3. Verify that surface plane flatness and fastening of steel roof deck comply with requirements in Section 053100 - STEEL DECKING.

4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.

5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.

6. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.

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

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.3 SUBSTRATE BOARD

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

1. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to membrane roofing system manufacturers' written instructions.

3.4 VAPOR-RETARDER INSTALLATION

A. Self-Adhering Sheet Vapor Retarder at 80 Mils Areas: Prime substrate if required by manufacturer. Install self-adhering sheet vapor retarder over area to receive vapor retarder, side, and end lapping each sheet a minimum of 3-1/2 inches and 6 inches, respectively. Seal laps by rolling.

3.5 ADHERED ROOFING MEMBRANE INSTALLATION

A. Install roofing membrane over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll roofing membrane and allow to relax before installing.

B. Start installation of roofing membrane in presence of membrane roofing system manufacturer's technical personnel.

C. Accurately align roofing membrane and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply solvent-based bonding adhesive to substrate and underside of roofing membrane at rate required by manufacturer and allow to partially dry before installing roofing membrane. Do not apply bonding adhesive to splice area of roofing membrane.

E. Mechanically or adhesively fasten roofing membrane securely at terminations, penetrations, and perimeter of roofing as indicated on the Drawings.

F. Apply roofing membrane with side laps shingled with slope of roof deck where possible.

G. Seams: Clean seam areas, overlap roofing membrane, and hot-air weld side and end laps of roofing membrane according to manufacturer's written instructions to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of roofing membrane.

2. Verify field strength of seams a minimum of twice daily and repair seam sample areas.

3. Repair tears, voids, and lapped seams in roofing membrane that does not meet requirements.

H. Provide overlay membrane, fully adhered, at all seams in 80 mil roof area.

I. Spread sealant or mastic bed over deck drain flange at deck drains and securely seal roofing membrane in place with clamping ring.

3.6 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

B. Apply solvent-based bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply bonding adhesive to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean splice areas, apply splicing cement (except for heat-welded application), and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform roof tests and inspections and to prepare test reports.

B. Manufacturer’s Technical Representative: Engage a qualified manufacturer’s technical representative to perform roof tests and inspections and to prepare test reports. Provide inspection at end of first week of installation.

1. Perform daily seam weld tests.

C. Final Roof Inspection: Engage roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.

1. Notify Architect and the Owner 48 hours in advance of date and time of inspection.

D. Repair or remove and replace components of membrane roofing system where test results or inspections indicate that they do not comply with specified requirements.

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

3.8 PROTECTING AND CLEANING

A. Protect membrane-roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and the Owner.

B. Correct deficiencies in or remove membrane-roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane-roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 076200

FLASHING AND SHEET METAL
(Part of Work of Section 07000 - ROOFING AND FLASHING, Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: G000; G001; A002, A101-5, A201-208, A301-2, A401-2, A701.

B. Sub-sub Bids are not required for this trade.

1.3 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Rough carpentry for nailers, cants, and blocking.

2. Cutting of flashing reglets into precast concrete to receive new flashings.

3. Sheet metal flashing and trim for the following applications:

a. Formed wall flashing and trim.

b. Formed low-slope roof flashing and trim.

B. Alternates: Not Applicable.

C. Items To Be Installed Only: Not Applicable.

D. Items To Be Furnished Only: Not Applicable

E. Related Work: The following items are not included in this Section and will be performed under the designated Sections:

1. Section 07540 - POLYVINYL CHLORIDE (PVC) MEMBRANE ROOFING for installing sheet metal flashing and trim integral with roofing membrane.

2. Section 07710 – ROOF ACCESSORIES for installing Galvalume gutters and downspouts with accessories.

1.4 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Fabricate and install roof edge flashing and copings capable of resisting the Wind Zone forces required by Code according to recommendations in FMG Loss Prevention Data Sheet 1-49.

C. 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.

D. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:

1. Identify material, thickness, weight, and finish for each item and location in Project.

2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.

3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.

4. Details of expansion-joint covers, including showing direction of expansion and contraction.

C. 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.

2. Trim: 12 inches long. Include fasteners and other exposed accessories.

3. Accessories: Full-size Sample.

1.6 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

1.7 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.

1.8 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. Copings:

1. Zinc/Tin Alloy-Coated Copper Sheet: ASTM B 370-03, Temper H00 and H01, cold-rolled copper sheet, of weight indicated below, coated both sides with zinc/tin alloy approximately 0.5 mils thick.

a. Use 20 oz. sheet for copings and counterflashing cleats.

b. Use 20 oz. sheet for thru-wall scuppers.

c. Use 16 oz. sheet for counterflashings and VTR caps.

B. Underlayment Materials

C. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

D. Slip Sheet: Rosin-sized paper, minimum 3 lb./100 sq. ft.

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.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.

2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.

3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

C. Solder:

1. Stainless Steel: ASTM B 32, Grade Sn60, with phosphoric acid based flux as recommended by manufacturer.

2. Zinc Alloy Copper: ASTM B 32, Grade Sn95, 95 percent tin, 5 percent antimony. Product: #497 SuperFlo by Johnson Manufacturing Co., Princeton, IA. Use with Johnson's E-127 Flux-'N-Solder with Pure Tin soldering flux.

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 polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. 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.

2.3 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.

B. 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.

C. 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.

1. Copper Seams: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

D. Fabricate plumbing vent flashings with separate cap from zinc/tin alloy coated copper.

E. Fabricate flashings for plumbing vents and pitch pans with a minimum 4 in. wide 4 lb. lead flange extended completely around flange periphery.

F. Fabricate end caps for ends of open base flashings with concealed fasteners.

G. Form pieces in single length sheets.

H. Fabricate continuous cleats to design shown on Drawings interlockable with sheet. Provide cleat with 3/4 in. lock.

I. Hem exposed edges 1/2 in. to underside.

J. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

K. 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 elastomeric sealant concealed within joints.

L. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

M. 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" for application but not less than thickness of metal being secured.

2.4 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Coping covers: Fabricate in minimum 96-inch-long, but not exceeding 10-foot- long, sections. Furnish with 8-inch-wide joint cover plates. Provide membrane flashing between cover plates.

B. Thru-Wall Scuppers: Fabricate to meet Drawing requirements.

2.5 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 PROTECTION

A. Protect paved areas, building and its contents, autos, trucks, and the site from the effects of work in this Section and against all risks associated with this Work. Repair all damage to the building and appurtenances as a result of the work of this Section to the condition at start of work, or if this cannot be determined, to the original condition, by approved means at no extra cost.

3.2 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

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

3.3 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. Torch cutting of sheet metal flashing and trim is not permitted.

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. Coat side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.

2. 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.

3. 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 elastomeric 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 counterflashing 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 elastomeric 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.

H. Soldered joints with membrane flashing at expansion joints.

1. 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.

a. 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.

3.4 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. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless steel draw band and tighten.

C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or 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 elastomeric sealant.

1. Secure in a waterproof manner by means of snap-in installation and sealant.

D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:

1. Seal with elastomeric sealant and clamp flashing to pipes penetrating roof except for flashing on vent piping.

3.5 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated.

3.6 FIELD QUALITY CONTROL

A. Cooperate with field quality control personnel. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.

B. Additional inspections and retesting of materials which fail to comply with specified material and installation requirements shall be performed at Contractor's expense.

3.7 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. 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.

D. 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

SECTION 077100

ROOF SPECIALTIES
(Part of Work of Section 07000 - ROOFING AND FLASHING, Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 -GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS. The Work of this section is shown on Drawings: G000; G001; A002, A101-5, A201-208, A301-2, A401-2, A501-2, A701.

B. Sub-sub Bids are not required for this trade.

1.3 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Wood nailers, curbs, and blocking.

2. Roof-edge fascia and rakes.

3. Metal Soffit Materials.

4. Gutters, scuppers, and downspouts.

B. Alternates: Not Applicable.

C. Items To Be Installed Only: Not Applicable.

D. Items To Be Furnished Only: Not Applicable.

E. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 075419 – POLYVINYL CHLORIDE (PVC) ROOFING.

2. Section 076200 - SHEET METAL FLASHING AND TRIM for flashing.

3. Section 079200 - JOINT SEALANTS for sealants.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent 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 thermal movements. Base calculations 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.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof specialties. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant-and field-assembled work. Include the following:

1. Details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.

2. Pattern of seams and layout of fasteners, cleats, clips, and other attachments.

3. Details of termination points and assemblies, including fixed points.

4. Details of special conditions.

C. Samples for Verification: For roof-edge drainage systems made from 12-inch lengths of full-size components including fasteners, cover joints, accessories, and attachments.

1.6 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical roof edge, including gutter and downspout approximately 10 feet long, including supporting construction, seams, attachments, and accessories.

2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof specialties installation.

PART 2 - PRODUCTS

2.1 EXPOSED METALS AND ROOF-EDGE DRAINAGE SYSTEMS

A. Fascia and Rakes.

1. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

a. Surface: Smooth, flat finish.

b. Exposed Coil-Coated Finishes at Fascia and Rakes: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1) Two-Coat Fluoropolymer: AAMA 620. System consisting of primer and fluoropolymer color topcoat containing not less than 70 percent PVDF resin by weight. Custom color per Architect.

B. Gutters, Scupper and Downspouts

1. Hanging Gutters: K style gutters fabricated from 26 gauge Galvalume, 7” size. Finish to be natural finish Galvalume.

2. Scupper: fabricated from 26 gauge Galvalume, 7” size. Finish to be natural finish Galvalume.

3. Downspouts, 3” x 4” rectangular downspouts, fabricated from 26 gauge Galvalume. Finish to be natural finish Galvalume.

4. Heavy duty wall brackets, furnish brackets at 60 inch minimum spacing.

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

1. ATAS International, Inc.

2. Berger Building Products, Inc.

3. Cheney Flashing Company.

4. Hickman Company, W. P.

5. Merchant & Evans, Inc.

6. Metal-Era, Inc.

7. Metal-Fab Manufacturing, LLC.

2.2 CONCEALED METALS

A. Aluminum Sheet: ASTM B 209, alloy and temper recommended by manufacturer for type of use and structural performance indicated, mill finished.

B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by manufacturer for type of use and structural performance indicated, mill finished.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F.

2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F.

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

a. Carlisle Coatings & Waterproofing; CCW WIP 300HT.

b. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.

c. Henry Company; Blueskin PE200 HT.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:

1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.

2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.

C. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 ROOF-EDGE FASCIA AND RAKES

A. Roof-Edge Fascia and Rakes: Manufactured roof-edge fascia consisting of snap-on metal fascia cover in section lengths not exceeding 12 feet and a continuous formed wood blocking to engage fascia cover. Provide matching corner units.

1. Cover: Fabricated from the following exposed metal:

a. Formed Aluminum: 0.032 inch.

2. Corners: Factory mitered and continuously welded.

3. Splice Plates: Concealed, of same material, finish, and shape as fascia cover.

2.6 METAL SOFFIT PANELS

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

1. Alcoa

2. Air Vent, Inc.

3. Petersen Aluminum

B. Soffit Panels: 12” wide traditional perforated v-groove panels, .019” thick aluminum, smooth texture, factory finished in color to be selected from manufacturers standard color range. Basis of Design is Alcoa SVG12V20

2.7 GENERAL FINISH REQUIREMENTS

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: Noticeable variations in same piece are not acceptable. 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.

D. Gutters to be placed below the slope line so that snow and ice can slide clear.

E. Fabricate gutters to fit locations and trim conditions, standard size to be 7” profile in width. Fabricate complete with end pieces, outlet tubes and other accessories as required. Fabricate in minimum 96 inch long sections. Furnish flat-stock gutter spacers and gutter brackets fabricated from same metal as gutters. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters.

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 the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

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

3.2 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.

2. Provide uniform, neat seams with minimum exposure of solder and sealant.

3. Install roof specialties to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.

4. Torch cutting of roof specialties is not permitted.

5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise shown on Drawings.

2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that will penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Seal joints as required for watertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F

F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches except reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.3 ROOF-EDGE DRAINAGE-SYSTEM INSTALLATION

A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.

B. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch away from walls; locate fasteners at top and bottom and at approximately 60 inches o.c.

1. Provide elbows at base of downspout to direct water away from building.

C. Conductor Heads: Anchor securely to wall with elevation of conductor top edge 1 inch below gutter discharge.

3.4 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 079200

JOINT SEALANTS
(Filed Sub-Bids Required)

PART 1 - GENERAL

1.1 GENERAL REFERENCE

A. The work of this Section is integral with the whole of the Contract Documents and is not intended to be interpreted outside that context.

1.2 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: A001, A101, A102, A103, A104, A204, A206, A207, A501, A502, A701, S003, S004, S005, S103, S104, S106, S201, S202, S203, A204, S301, S302, S303.

B. Sub-sub Bids are not required for this trade.

1.3 DESCRIPTION OF WORK

A. The extent of sealant and caulking work shall be as specified herein and at all the following joint locations unless specifically excluded or detailed with other materials:

1. All precast to precast joints, including grouted joints exposed to view.
2. All precast to curtain wall and store front joints.
3. All store front to store front joints.
4. All masonry to precast joints.
5. All precast lifting loops and recesses.
6. All masonry to masonry joints.
7. All cast-in-place to precast joints.
8. All cast-in-place to curtainwall and store front joints.
9. All masonry to store front joints.
10. All curtainwall to precast joints.
11. All roof level plumbing chases.

1.4 ALTERNATES (NOT USED)

1.5 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 30 00 – Cast in Place Concrete

B. Section 03 41 00 – Structural Precast Concrete

C. Section 04 20 00 – Unit Masonry

D. Section 07 95 00 – Expansion Control

1.6 SHOP DRAWINGS (NOT USED)

1.7 SAMPLES (NOT USED)

A. Initial Selection Samples: Submit samples showing complete range of colors, textures and finishes available for each material used.

B. Verification Samples: Submit representative samples of each material that is to be exposed in the finished work, showing the full range of color and finish variations expected.

C. Submit the following samples:

1. Submit color samples of caulking from which the Architect will select color.

1.8 PRODUCT LITERATURE

A. Manufacturer's Data: Submit manufacturer's specifications, recommendations and installation instructions for sealant, caulking compound and associated miscellaneous material required. Include manufacturer's published data, or letter of certification, or certified test laboratory report indicating that each material complies with the requirements and is intended generally for the applications shown.

1.9 MOCK UPS

A. Install selected color sealants in lengths of no less than (3) three feet at locations selected by the architect for review and approval. Remove mock-up sealants at direction of architect. Upon removal of mockup sealants, prepare, prime, and apply selected sealants in accordance with this section

1.10 DELIVERY, STORAGE AND HANDLING

A. Materials shall be delivered and stored in original, unopened manufacturer's containers with brand marked clearly thereon. Materials shall be stored in a dry location, protected from adverse conditions.

1.11 COORDINATION

A. Examine all surfaces to receive work of this Section and report to the Architect any condition which is not acceptable. Commencement of work on any continuous run constitutes acceptance of conditions and places the responsibility of a sound installation on this section.

B. Weather Conditions: Do not proceed with installation of sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations

for installation. Proceed with the work only when forecasted weather conditions are favorable for proper cure and development of high early bond strength. Wherever joint width is affected by ambient temperature variations, install elastomeric sealants only when temperatures are in the lower third of manufacturer's recommended installation temperature range, so that sealant will not be subjected to excessive elongation and bond stress at subsequent low temperatures. Coordinate time schedule to avoid delay of project.

1.12 QUALITY ASSURANCE

A. Manufacturer shall send a qualified technical representative to project site for the purpose of advising the installer of proper procedures and precautions for the use of the materials.

1.13 WARRANTIES

A. Attention is directed to provisions of the CONDITIONS OF CONTRACT regarding guaranties and warranties.

1.14 Manufacturers shall provide their standard guaranties for work specified in this Section. However, such guaranties shall be in addition to and not in lieu of all other liabilities which manufacturers and Contractor may have by law or by other provisions of the Contract Documents.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS (NOT USED)

A. Two Component Polyurethane Non Sag Sealant:

1. Products offered by manufacturers to comply with the requirements include the following:

a. “Sikaflex-2C-NS,” Sika Corporation.

b. THC-901; Tremco Mfg. Company

c. Sonolastic NP2; Sonneborn Building Products

B. Two Component Polyurethane Self Leveling Sealant:

1. Products offered by manufacturers to comply with the requirements include the following:

a. Sikaflex-2C-SL, Sika Corporation.

b. Sonolastic SL2; Sonneborn Building Products

c. “Vulkem 245/255 or THC/900”: Tremco Mfg. Co.

d. 790 Silicone Sealant : Dow Corning

C. Preformed Expanding Foam Joint Sealants

1. Products offered by manufacturers to comply with the requirements include the following:

a. InverSeal : Watson Bowman Acme

b. Iso-Flex Precom B : Lymtal International, Inc.

c. 20H System : Emseal

2.2 MATERIALS

A. Caulking/Sealant

1. Application:

a. Provide two component polyurethane, non-sag sealant at vertical and horizontal joints.

b. Provide two component polyurethane self-leveling sealant at joints subject to traffic conditions.

c. Provide polyurethane joint fillers at expansion joints shown to be caulked.

d. Provide bituminous joint fillers at concrete installations not required to be caulked.

2. Two Component Polyurethane Non Sag Sealant:

a. ASTM 920, Class A, Type 2, proprietary two component primerless sealant.

3. Two Component Polyurethane Self Leveling Sealant:

a. Polyurethane based, 2 part elastomeric sealant, complying with ASTM 920, Class A, Type 1 unless Type 2 (non-sag) is recommended by manufacturer for the application shown.

B. Primer and Fillers

1. Joint Cleaner: Provide the type of joint cleaning compound recommended by the sealant or caulking compound manufacturer, for the joint surfaces to be cleaned.

2. Joint Primer/Sealer: Provide the type joint primer/sealer recommended by the sealant manufacturer, for the joint surfaces to be primed or sealed.

3. Bond Breaker Tape: Polyethylene tape or other plastic tape as recommended by the sealant manufacturer, to be applied to sealant contact surfaces where bond to the substrate or joint filler must be avoided for proper performance of sealant. Provide self-adhesive tape wherever applicable.

4. Sealant Backer Rod: Compressible rod stock polyethylene foam, polyethylene jacketed polyurethane foam, butyl rubber foam, neoprene foam or other flexible, permanent, durable non absorptive closed-cell or “hybrid” material as recommended for compatibility with sealant by the sealant manufacturer. Provide size and shape of rod which will control the joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead on back side, and provide a highly compressible backer to minimize the possibility of sealant extrusion when joint is compressed.

C. Cellular Foam Expansion Joint Fillers

1. Expanded Polyethylene Joint Filler:

a. Provide flexible, compressible, closed-cell polyethylene of not less than 10 psi compression deflection (25%); except provide higher compression deflection

strength as may be necessary to withstand installation forces and provide proper support for sealants; surface water absorption of not more than 0.1 lbs. per sq. ft.

b. Products offered by manufactured to comply with the requirements include the following:

1) Ethafoam SB: Dow Chemical Co.

2) Sonofoam; Sonneborn Building Products.

3) Expand O Foam; Williams Products, Inc.

2. Concrete Control – Expansion Joint Fillers

3. Bituminous and Fiber Joint Filler:

a. Provide resilient and non-extruding type premolded bituminous impregnated fiberboard units complying with ASTM D1751 73 (78), FS HH F 341 F 77, Type I and AASHTO M213 74.

b. Products offered by manufacturers to comply with the requirements include the following:

1) Flexcell; Celotex Corporation

2) Cane Fiber 1290; W. R. Grace & Co.

3) Fibre; W. R. Meadows, Inc.

D. Preformed Expanding Foam Joint Sealants

1. Proved preformed foam waterproofed foam expanded foam joint sealant intended for below grade application.

2.3 MIXES (NOT USED)

2.4 FABRICATION (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION AND INSPECTION

A. Joint Sealant and Joint Preparation

1. Joint Surface Preparation: Clean joint surfaces immediately before installation of sealant or caulking compound. Remove dirt, insecure coatings, moisture and other substances which would interfere with bond of sealant or caulking compound.

a. Review joint size and shape for conformance with drawings and sealant manufacture's recommendations. Provide sufficient notification to contractor of non-conforming conditions to allow re-profiling of joints.

b. Non-conforming joint sizes shall be ground to size and shape. In the event grinding cannot modify joint precast component shall be adjusted to provide a conforming condition.

c. Etch concrete and masonry joint surfaces to remove excess alkalinity, unless sealant manufacturer's printed instructions indicate that alkalinity does not interfere with sealant bond and performance.

3.2 WORKMANSHIP, PERFORMANCE (NOT USED)

3.3 INSTALLATION/APPLICATION/ERECTION

A. Joint Sealant Application:

1. Installation: Comply with sealant manufacturer's printed instructions except where more stringent requirements are shown or specified and except where manufacturer's technical representative directs otherwise.

a. Prime or seal the joint surfaces as required by product data specifications. Do not allow primer/sealer to spill or migrate onto adjoining surfaces.

b. Install sealant backer rod for sealants, except where recommended to be omitted by sealant manufacturer for the application shown.

c. Install bond breaker tape as required by manufacturer's recommendations to ensure that sealants will perform properly.

d. Employ only proven installation techniques, which will ensure that sealants will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of the joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

e. Install sealants to depths as recommended by the sealant manufacturer but within the following general limitations, measured at the center (thin) section of the bead.

1) For pavements and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75% of joint width, but not more than 5/8 inch deep or less than 3/8 inch deep.

2) For normal moving joints sealed with elastomeric sealants, but not subject to traffic, fill joints to a depth equal to 50% of joint width, but not more than ½ inch deep or less than 1/4 inch deep.

2. Cure and Protection:

a. Cure sealants and caulking compounds in compliance with manufacturer's instructions and recommendations to obtain high early bond strength, internal cohesive strength and surface durability.

B. Joint Fillers

1. Set units at proper depth or position in the joint to coordinate with other work, including the installation of bond breakers, backer rods and sealants. Do not leave voids or gaps between the ends of joint filler units.

3.4 FIELD QUALITY CONTROL (NOT USED)

3.5 CLEANING AND PROTECTION

A. Spillage: Do not allow sealants or compounds to overflow or spill onto adjoining surfaces. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces, by either the primer/sealer or the sealant/caulking compound.

B. Remove excess and spillage of compounds promptly as the work progresses. Clean the adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage, without damage to the adjoining surfaces or finishes.

C. Provide all procedures required for the protection of sealants and caulking compounds during the construction period, so that they will be without deterioration or damage (other than normal wear and weathering) at the time of acceptance

3.6 EXTRA STOCK/SPARE PARTS (NOT USED)

3.7 SCHEDULES (NOT USED)

END OF SECTION

SECTION 079500

EXPANSION CONTROL
(Filed Sub-Bids Required)

PART 1 - GENERAL

1.1 GENERAL REFERENCE

A. The work of this Section is integral with the whole of the Contract Documents and is not intended to be interpreted outside that context.

1.2 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: A101, A207, A701, S001, S003, S004, S005, S103, S104, S121, S201.

B. Sub-sub Bids are not required for this trade.

1.3 DESCRIPTION OF WORK

A. Provide all labor, materials, equipment, services and accessories necessary to furnish and install the work of this Section, complete and functional, as indicated in the Contract Documents and as specified herein.

B. The principal work of this Section includes, but may not be limited to, the following:

1. Horizontal deck joint seals at transition to initial double tee at ramp.
2. Expansion joint at top of curtain wall and precast roof plank at south stair

1.4 ALTERNATES (NOT USED)

1.5 RELATED WORK SPECIFIED ELSEWHERE

A. Section 03 30 00 Cast-In-Place Concrete

B. Section 03 41 00 - Structural Precast Concrete

C. Section 07 92 00 – Joint Sealants

1.6 SHOP DRAWINGS

A. Shop Drawings: Submit shop drawings for installation of expansion joints. Include plans and details of sections and connections. Show anchorage and accessory items.

1.7 SAMPLES (NOT USED)

A. Initial Selection Samples: Submit samples showing complete range of colors, textures and finishes available for each material used.

B. Verification Samples: Submit representative samples of each material that is to be exposed in the finished work, showing the full range of color and finish variations expected.

C. Submit the following samples:

1. Submit sample of expansion joint, not less than 6 inches long.
2. Submit manufacturers color palette for expansion joints subject to façade and architectural treatments

1.8 PRODUCT LITERATURE

A. Manufacturer's Data: Submit specifications, installation instructions and general recommendations from the expansion joint material manufacturer, for the type of product required.

B. Warranty: Submit Contractor’s warranty for review and acceptance prior to commencement of expansion joint work.

1.9 MOCK UPS (NOT USED)

1.10 DELIVERY, STORAGE AND HANDLING

A. All materials shall be delivered on the job and stored in a place protected from damage, moisture and exposure to the elements in exact accordance with manufacturer's instructions.

1.11 COORDINATION

A. Weather Conditions: Do not proceed with installation of expansion joints and sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation. Proceed with the work only when forecasted weather conditions are favorable for proper cure and strength development of the adhesive materials.

1.12 QUALITY ASSURANCE

A. Manufacturer's qualifications.

1. Manufacturer's Instructions: In addition to the requirements of these specifications, comply with manufacturer's instructions and recommendations for all phases of the work, including preparation of substrate, application of materials, and protection of installed units.

a. The manufacturer will verify that the expansion joint system is properly sized for the movement expected in the structure.

b. The manufacturer will verify or make recommendations regarding the size of concrete block outs to receive the expansion joint system taking into consideration climate conditions at the time concrete is placed and shrinkage of concrete.

c. The manufacturer will insure that the expansion joint system is set at the proper width to account for variations in the concrete joint opening due to temperature conditions at the time of installation.

d. The manufacturer and approved applicator shall guarantee the expansion joint system for a period of five (5 years). Any type of failure of the new joint system which occurs within the specified warranty period shall be repaired or replaced by the Contractor at no cost to the Owner.

e. Consult the Manufacturer's representative and establish the minimum provisions required to ensure satisfactory work.

f. The expansion joint system shall meet or exceed any fire rating requirements set forth by the local building code requirements.

g. Expansion joint systems intended for accessible pathways shall conform to Americans with Disabilities Accessibility (ADA) guidelines.

B. Subcontractor's qualifications.

C. The installer shall be licensed by the manufacturer of the joint system.

1.13 WARRANTIES

A. Attention is directed to provisions of the CONDITIONS OF CONTRACT and applicable parts of Division 1 regarding guaranties and warranties.

B. Manufacturers shall provide their standard guaranties for work specified in this Section. However, such guaranties shall be in addition to and not in lieu of all other liabilities which manufacturers and Contractor may have by law or by other provisions of the Contract Documents.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Horizontal expansion joints at supported floor slab, tee to tee:

1. BASF/Watson Bowman: WaboCrete ME Series Membrane (model as applicable)

2. Emseal: Thermaflex TCR System (model as applicable)

3. Lymtal International, Inc.: Iso-Flex Winged J-Series (model as applicable)

2.2 MATERIALS

A. The expansion joint seal system shall be a complete system of compatible materials designed by the manufacturer to produce a waterproof, traffic-bearing expansion joint seal.

B. The gland elements shall be a continuous, factory extruded unit for the entire straight run length of the joint. Changes in direction or elevation shall be accomplished by factory molded elbows, tees, crosses and the like. The seal shall be turned up a minimum of 6 inches (vertically) unless otherwise shown on plans. The seal element shall not be mitered/jointed unless approved by the Consultant in writing.

C. Due to variations in specific details of the locations, expected movement, expected traffic exposure, all systems are not suitable for one particular condition. The Contractor shall reference the specific expansion joint detail and approved products shown on the drawings, including gland size, etc. for the respective condition.

D. Contractor shall review specific details on drawings regarding products and model numbers approved for use.

2.3 MIXES (NOT USED)

2.4 FABRICATION (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION AND INSPECTION (NOT USED)

A. Preparation

1. The block-out shall be provided to the specified dimensions as indicated on the drawing and acceptable to the manufacturer. Any edge raveling at the joint opening or spalls shall be repaired with a suitable compound to provide a solid, square block-out.

2. The block-out substrate shall be sandblasted clean of all contaminants and impurities immediately prior to the system installation to assure proper adhesion.

3. The membrane gland element shall be unpackaged and laid in a relaxed position to believe any temporary set from shipment packaging prior to placement. The pre-molded element shall be wiped clean with a solvent solution such as toluene.

4. Adjacent deck surfaces shall be taped off and protected to assure a clean, neat professional installation.

3.2 WORKMANSHIP, PERFORMANCE (NOR USED)

3.3 INSTALLATION/APPLICATION/ERECTION

A. Installation

1. The entire installation shall be made in accordance with the manufacturer's written instruction.

2. Follow standard manufacturer’s recommendation for installation of the material, including block-out dimensions, joint width and ambient temperature conditions.

3.4 FIELD QUALITY CONTROL

A. All expansion joint seals shall be tested by applying water and by flooding for a minimum of 24 hours. Any leaking observed shall be rectified by the Contractor and the joint shall be re-tested until no leakage is observed. It is the responsibility of the Contractor to absolutely make certain that the joints are totally waterproofed.

3.5 CLEANING AND PROTECTION (NOT USED)

3.6 EXTRA STOCK/SPARE PARTS (NOT USED)

3.7 SCHEDULES (NOT USED)

END OF SECTION

SECTION 08113

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Standard hollow-metal steel doors.

2. Standard hollow-metal steel frames.

3. Fire-rated frames.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 08710 - DOOR HARDWARE for door hardware for steel doors.

2. Section 09900 - PAINTING AND COATING for field painting steel doors and frames.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance rating, temperature-rise ratings, and finishes for each type of steel door and frame specified.

B. Shop Drawings:

1. Elevations of each door design.

2. Details of doors, including vertical and horizontal edge details and metal thicknesses.

3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.

4. Locations of reinforcement and preparations for hardware.

5. Details of each different wall opening condition.

6. Details of anchorages, joints, field splices, and connections.

7. Details of accessories.

C. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

D. Product Test Reports: Based on evaluation of comprehensive fire tests performed by a qualified testing agency, for each type of standard steel door and frame.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain standard steel doors and frames through one source from a single manufacturer.

C. Fire-Rated Door Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch-high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

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

1. Amweld Building Products, LLC.

2. Ceco Door Products; an ASSA ABLOY Group Company.

3. CURRIES Company; an ASSA ABLOY Group Company.

4. de LaFontaine

5. Mesker Door Inc.

6. Pioneer Industries, Inc.

7. Philipp Manufacturing Company.

8. Republic Builders Products Company.

9. Steelcraft; an Ingersoll-Rand company.

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 G60 metallic coating.

D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 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: Hot-dip galvanized according to ASTM A 153/A 153M.

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

H. ASTM C 143/C 143M.

I. 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.

J. 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.

2.3 STANDARD STEEL DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8.

1. Design: Flush panel.

2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, mineral-board, or vertical steel-stiffener core that produces doors complying with ANSI A250.8.

3. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch-thick end closures or channels of same material as face sheets.

5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:

1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless), 1-3/4 inches thick.

C. Description: Provide flush-design sound- control doors, 1-3/4 inches thick, of seamless construction; with manufacturer’s standard sound-retardant core as required to provide STC and fire rating indicated. Construct doors with smooth, flush surfaces without visible joints or seams on exposed faces or stile edges. Fabricate according to ANSI/NAAMM-HMMA 865.

D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD STEEL FRAMES

A. General: Comply with ANSI A250.8 and with details indicated for type and profile.

B. Exterior Frames: Fabricated from metallic-coated steel sheet.

1. Fabricate frames with mitered or coped and welded face corners and seamless face joints.

2. Frames for Level 3 Steel Doors: 0.067-inch-thick steel sheet.

C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2. 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.

2.6 HOLLOW METAL PANELS

A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.7 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

C. Hollow Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and not visible.

2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.

4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.

5. Jamb Anchors: Provide number and spacing of anchors as follows:

a. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

6. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.

a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Section 087100 - DOOR HARDWARE.

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.

2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.

3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.

4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 - ELECTRICAL.

2.8 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

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

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 the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

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

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.

3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.

4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

a. At fire-protection-rated openings, install frames according to NFPA 80.

b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.

c. Install door silencers in frames before grouting.

d. Remove temporary braces necessary for installation only after frames have been properly set and secured.

e. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

f. Field apply bituminous coating to backs of frames that are filled with grout.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.

b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.

c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.

d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.

b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch .

c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.

d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer. Primer shall be compliant with low-emitting requirements as herein stated.

D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

SECTION 08413

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 SCOPE OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Exterior aluminum-framed storefronts at stairwells.

2. Exterior manual-swing aluminum doors.

3. Provide and install all glazing, including tinted glazing for exterior storefront system.

B. Related Work: The following items are not included in this Section:

1. Section 07920 - JOINT SEALANTS for installation of joint sealants installed with aluminum-framed systems and for sealants to the extent not specified in this Section.

2. Section 84411 – GLAZED ALUMINUM CURTAIN WALL for glazed enclosure of south stairwell.

3. Section 87100 - DOOR HARDWARE for lock cylinders and keying.

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide aluminum-framed systems, including anchorage, capable of withstanding, without failure, the effects of the following:

1. Structural loads.

2. Thermal movements.

3. Dimensional tolerances of building frame and other adjacent construction.

4. Failure includes the following:

a. Deflection exceeding specified limits.

b. Thermal stresses transferred to building structure.

c. Framing members transferring stresses, including those caused by thermal and structural movements, to glazing.

d. Noise or vibration created by wind and thermal and structural movements.

e. Loosening or weakening of fasteners, attachments, and other components.

f. Sealant failure.

B. Structural Loads: Wind and seismic loads as indicated on the Structural Drawings, but not less than that required by Code.

C. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.

2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller, amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components directly below to less than 1/8 inch and clearance between members and operable units directly below to less than 1/16 inch.

D. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. 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. Air Infiltration Test: Test unit in accordance with ASTM E 283, as follows:

1. Static Air Pressure Difference: 6.24 psf for fixed storefront units, and 1.567 psf for doors.

2. Performance: Maximum air leakage shall not exceed the following: fixed storefront units,1.0 cfm/sf.: glazed entrance door units, 0.3 cfm/sf of other areas.

F. Water Leakage Test: Test fixed framing system in accordance with ASTM E 331.

1. Test Pressure: 8 psf.

2. Performance: No leakage as defined in test method at specified test pressure. No uncontrolled water penetrating system or appearing on normally exposed interior surfaces.

G. Solar Heat-Gain Coefficient: Provide units with a whole-unit SHGC maximum of 0.40, as required by the Massachusetts Stretch Code, determined according to NFRC 200 procedures. Submit proof of compliance with submittals as specified.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of product indicated.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.

1. Include structural analysis data signed and sealed by the qualified professional engineer registered in the state the project is located, responsible for their preparation.

2. Include structural analysis of story drift and deflection from anticipated live loads, and determination whether head receptors are required.

3. Include details of provisions for system expansion and contraction and for draining moisture occurring within the system to the exterior.

4. For entrances, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

D. Qualification Data: For Installer.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems.

F. Performance Reports: Based on systems, components and glazing methods proposed for use on this Project, proof that units as glazed for this Project meet or exceed Code requirements for the following:

1. Solar heat-gain coefficient.

G. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

H. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Capable of assuming engineering responsibility and performing work of this Section and who is acceptable to manufacturer.

1. Engineering Responsibility: Preparation of data for aluminum-framed systems including Shop Drawings based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project and submission of reports of tests performed on manufacturer's standard assemblies.

B. Accessible Entrances: Comply with authorities having jurisdiction, local state building code and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."

C. Mock-Ups: Build mock-ups of entrance as directed by the Architect.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating aluminum-framed systems

without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 WARRANTY

A. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

B. Performance Warranty: Provide a written warranty assuming full responsibility for the satisfactory performance of each system including but not limited to, framing, hardware, doors, anchorage, setting, perimeter sealing, flashing and other work as it relates to the performance of the system. Repair or replace all work not meeting specified performance requirements including removal and replacement of covering or connected work.

1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Storefront, Thermal Break, 1 3/4 inch by 6 inch profile, front glazed:

a. Basis-of-Design: Oldcastle North America, Trifab 601UT.

b. Kawneer North America, Trifab 601UT.Tubelite Inc., 14650T.

2. Doors, Wide Stile:

a. EFCO, a Pella Company, D-500.

b. Kawneer North America, 500.

c. Tubelite Inc., Wide.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209.

2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.

3. Extruded Structural Pipe and Tubes: ASTM B 429.

4. Structural Profiles: ASTM B 308/B 308M.

5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.

2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.

3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermal-break.

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.

2. Reinforce members as required to receive fastener threads.

3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

E. Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials. Form exposed flashing from sheet aluminum finished to match framing and of sufficient thickness to maintain a flat appearance without visible deflection.

F. Framing System Gaskets and Sealants: Manufacturer's standard recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

A. Tempered Glass for Vertical Exterior Glazing (Type IT): 1/4 inch tempered glass, low e coating on the No. 2 surface. Provide one of the following or equal:

1. Basis-of-Design: Tempered by AGC Flat Glass North America.

a. Visible Light Transmittance: 70 percent.

b. Solar Heat Gain Coefficient: 0.37.

2. VE1-2M by Viracon.

a. Visible Light Transmittance: 70 percent.

b. Reflectance Visible Light: 11 percent.

c. Shading Coefficient: 0.43.

d. Solar Heat Gain Coefficient: 0.37.

3. Solarban 60 by PPG Industries.

a. Visible Light Transmittance: 70 percent.

b. Reflectance Visible Light: 11 percent.

c. Shading Coefficient: 0.44.

d. Solar Heat Gain Coefficient: 0.38.

4. SN-68 by Guardian Industries.

a. Visible Light Transmittance: 68 percent.

b. Reflectance Visible Light: 10 percent.

c. Shading Coefficient: 0.43.

d. Solar Heat Gain Coefficient: 0.37.

2.5 DOORS

A. Doors: Manufacturer's standard glazed doors, for manual swing operation.

1. Door Construction: Mechanical clip fastening, SIGMA deep penetration plus welds and 1-1/8 inch long fillet welds inside and outside of all four corners. Glazing stops shall be hook-in type and EPDM glazing gaskets reinforced with non-stretchable cord.

2.6 DOOR HARDWARE

A. General: Provide heavy-duty units in sizes and types recommended by entrance system and hardware manufacturers for entrances and uses indicated.

1. Opening-Force Requirements:

a. Egress Doors: Not more than 30 lbf required to set door in motion and not more than 15 lbf required to open door to minimum required width.

B. Hardware Cores: Provide as specified in Section 087100 - DOOR HARDWARE.

2.7 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Section 079200 - JOINT SEALANTS.

B. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.8 FABRICATION

A. Form aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.

2. Accurately fitted joints with ends coped or mitered.

3. Means to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

4. Physical and thermal isolation of glazing from framing members.

5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.

6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing (without projecting stops).

E. Door Frames: Reinforce as required to support loads imposed by door operation and for installing hardware.

1. At exterior doors, provide compression weather stripping at fixed stops.

2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

F. Doors: Reinforce doors as required for installing hardware.

1. At pairs of exterior doors, provide sliding weather stripping retained in adjustable strip mortised into door edge.

2. At exterior doors that open to conditioned space, provide weather sweeps applied to door bottoms.

G. Hardware Installation: Factory install hardware to the greatest extent possible. Cut, drill, and tap for factory-installed hardware before applying finishes.

H. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. Base of Design Finish: Satin aluminum, clear anodized.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.

2. Do not install damaged components.

3. Fit joints to produce hairline joints free of burrs and distortion.

4. Rigidly secure nonmovement joints.

5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.

6. Seal joints watertight, unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.

2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 - JOINT SEALANTS and to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, without warp or rack.

F. Furnish and install glazing as specified.

1. Structural-Sealant Glazing:

a. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

b. Install weatherseal sealant according to Section 079200 - JOINT SEALANTS and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

G. Entrances: Install to produce smooth operation and tight fit at contact points.

1. Exterior Entrances: Install to produce tight fit at weather stripping and weathertight closure.

2. Field-Installed Hardware: Install surface-mounted hardware according to hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

H. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.

2. Alignment:

a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.

b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.

3. Diagonal Measurements: Limit difference between diagonal measurement to 1/8 inch.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner’s Project manager will determine compliance with specification performance levels.

1. Water Penetration: Areas shall comply with ASTM E 1105 at a minimum cyclic static-air-pressure difference of 0.67 times the static-air-pressure difference specified for laboratory testing under Part 1 "Performance Requirements" Article, but not less than 4.18 lbf/sq. ft., and shall not evidence water penetration.

B. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

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

3.4 ADJUSTING

A. Entrances: Adjust operating hardware for smooth operation according to hardware manufacturers' written instructions.

1. For doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch measured to the leading door edge.

3.5 PROTECTION AND CLEANING

A. Protect window surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor window surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact window surfaces, remove contaminants immediately according to manufacturer's written recommendations.

B. Clean aluminum surfaces immediately after installing windows. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

C. Clean factory-glazed glass immediately after installing windows. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels and clean surfaces.

D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION

SECTION 08441

GLAZED ALUMINUM CURTAIN WALL

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Aluminum curtain wall system with factory- installed glass and glazing and reinforced mullions, including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of curtain wall framing.

B. Alternates: Not Applicable.

C. Items To Be Installed Only: Not Applicable.

D. Items To Be Furnished Only: Not Applicable.

E. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 07920 - JOINT SEALANTS for sealing the frame perimeter.

2. Section 08413 - ALUMINUM FRAMED ENTRANCES AND STOREFRONTS

1.3 PERFORMANCE REQUIREMENTS

A. General: Provide a curtain wall system capable of complying with performance requirements indicated, based on testing manufacturer's curtain wall systems that are representative of those specified.

B. AAMA Performance Requirements: Provide a curtain wall system of the performance class and grade indicated that comply with AAMA 503.

1. Performance Class: CW- Commercial.

2. Performance Grade: Minimum for performance class indicated.

C. Structural Performance: Provide curtain walls capable of withstanding the following, including wind loads based on passing AAMA, Uniform Load Structural Test, at basic wind speed indicated:

1. Deflection: A static air design load of 40 psf (1915 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330. There shall be no deflection in

excess of L/175 of the span of any framing member at design load. At structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.

2. Wind Speed: 100 MPH.

3. Seismic: When tested to AAMA 501.4, system must meet design displacement of 0.010 x the story height and ultimate displacement of 1.5 x the design displacement.

D. Air Infiltration: The test specimen shall be tested in accordance with ASTM E 283. Air infiltration rate shall not exceed 0.06 cfm/ft^2 at a static air pressure differential of 6.24 psf (300 Pa).

E. Water Resistance: (static): The test specimen shall be tested in accordance with ASTM E 331. There shall be no leakage at a static air pressure differential of 12 psf (575 Pa) as defined in AAMA 501.

F. Water Resistance: (dynamic): The test specimen shall be tested in accordance with AAMA 501.1. There shall be no leakage at an air pressure differential of 12 psf (575 Pa) as defined in AAMA 501.

G. Solar Heat-Gain Coefficient: Provide system with a whole-window SHGC per below and determined according to NFRC 200 procedures. Submit proof of compliance with submittals as specified.

1. 0.40

H. Visible Light Transmittance: Provide system with a glazing visible light transmittance as follows:

1. Facades: varies, according to glazing option.

1.4 SUBMITTALS

A. Product Data: Include construction details, material descriptions, fabrication methods, dimensions of individual components and profiles, hardware, finishes, and operating instructions.

B. Shop Drawings: Include plans, elevations, sections, details, hardware, attachments to other Work, operational clearances, and the following:

1. Mullion details, including reinforcement and stiffeners.

2. Joinery details.

3. Expansion provisions.

4. Flashing and drainage details.

5. Weather-stripping details.

6. Glazing details.

7. Window cleaning provisions.

8. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation and used to determine the following:

a. Structural test pressures and design pressures from basic wind speeds.

b. Deflection limitations of glass framing systems.

C. Samples for Verification: For curtain wall system components required, prepared on Samples of size indicated below.

1. Main Framing Member: 12-inch-long, full-size sections of extrusions with factory-applied color finish.

2. Hardware: Full-size units with factory-applied finish.

3. Weather Stripping: 12-inch-long sections.

D. Qualification Data: For Installer and professional engineer.

E. Product Test Reports: Based on evaluation of comprehensive tests performed within the last four years by a qualified testing agency. Test results based on use of downsized test units will not be accepted.

F. Maintenance Data: For operable sash, operating hardware, weather-stripping and finishes to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An installer acceptable to curtain wall manufacturer for installation required for this Project.

B. 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.

C. Source Limitations: Obtain the curtain wall system through one source from a single manufacturer.

D. Product Options: Information on Drawings and in Specifications establishes requirements for curtain wall system aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

E. Fenestration Standard: Comply with AAMA guides, for minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.

1. Provide AAMA-certified system with an attached label.

F. Glazing Publications: Comply with published recommendations of glass manufacturers and GANA's "Glazing Manual" unless more stringent requirements are indicated.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:

1. Failure to meet performance requirements.

2. Structural failures including excessive deflection.

3. Water leakage, air infiltration, or condensation.

4. Faulty operation of hardware.

5. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

6. Glass failure.

B. Warranty Period: Two years from date of Substantial Completion.

C. Warranty Period for Metal Finishes: 20 years from date of Substantial Completion.

D. Warranty Period for Glass: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. The following products have been selected:

1. Curtain Wall System:

a. As manufactured by Kawneer Corporation.

2. Basis-of-Design: Series 1600 Wall System by Kawneer.

3. Equal products, by Wausau Window and Wall Systems, thermal curtain wall, or Thermal Curtain Wall by Oldcastle Building Envelope are acceptable, subject to compliance with requirements, manufacturers' offering products equal in aesthetic quality, function, and performance will be considered.

2.2 MATERIALS

A. Aluminum Extrusions: Manufacturer's standard formed sheet or extruded-aluminum. Provide aluminum alloy and temper recommended by window manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength, and not less than 16,000-psi minimum yield strength.

B. Member Wall Thickness: Each framing member shall have a wall thickness sufficient to meet the specified structural requirements.

C. Tolerances: Reference to tolerances for wall thickness and other cross-sectional dimensions of curtain wall members are nominal and in compliance with AA Aluminum Standards and Data.

D. Glazing Stops: Material and finish to match frame members.

E. Fasteners: Aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by manufacturer to be noncorrosive and compatible with wood window members, cladding, trim, hardware, anchors, and other components.

1. Exposed Fasteners: Unless unavoidable for applying hardware, do not use exposed fasteners. For application of hardware, use fasteners that match finish of member or hardware being fastened, as appropriate.

F. Gaskets: Glazing gaskets shall comply with ASTM C 864 and be extruded of a silicone compatible EPDM rubber that provides for silicone adhesion.

G. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

H. Reinforcing Members: Aluminum, or nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions; provide sufficient strength to withstand design pressure indicated.

I. Compression-Type Weather Stripping: Provide compressible weather stripping designed for permanently resilient sealing under bumper or wiper action and for complete concealment when wood window is closed.

1. Weather-Stripping Material: Elastomeric cellular preformed gaskets complying with ASTM C 509.

J. Sliding-Type Weather Stripping: Provide woven-pile weather stripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric. Comply with AAMA 701/702.

1. Weather Seals: Provide weather stripping with integral barrier fin or fins of semirigid, polypropylene sheet or polypropylene-coated material. Comply with AAMA 701/702.

K. Replaceable Weather Seals: Comply with AAMA 701/702.

2.3 GLAZING

A. Glass for Vertical Glazing: Minimum 1/4” inch tempered, Low-e glass, clear. For three colors shown on Drawings, provide tinted glass from manufacturer’s standard colors of bronze, blue, and green. Basis of Design: PPG Industries Inc.; or comparable product by one of the following:

1. Guardian Industries Corp.

2. Viracon, Inc.

2.4 FABRICATION

A. General: Fabricate the curtain wall system, in sizes indicated, for performance class and performance grade indicated. Include a complete system for assembling components and anchoring windows.

B. Fabricate components per manufacturer's installation instructions and with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

C. Weather Stripping: Provide full-perimeter weather stripping for each operable sash and ventilator, unless otherwise indicated.

D. Mullions: Provide steel reinforced mullions and cover plates as shown, matching the curtain wall system, complete with anchors for support to structure and installation. Allow for erection tolerances and provide for movement of the system due to thermal expansion and building deflections, as indicated. Provide mullions and cover plates capable of withstanding design loads.

E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

F. Arrange fasteners and attachments to conceal from view.

2.5 FINISHES

A. Aluminum Finish: Manufacturer's standard anodized brushed aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances; rough opening dimensions; levelness of sill plate; coordination with wall flashings, vapor retarders, and other built-in components; and other conditions affecting performance of work.

1. Concrete Surfaces: Visibly dry and free of excess cement, sand, and other construction debris.

2. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.

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

3.2 INSTALLATION

A. General: Comply with drawings, and shop drawings, and manufacturer's written instructions, for installing the curtain wall system, hardware, accessories, and other components.

B. Install curtain wall systems level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.

D. Metal Protection: Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified in "Dissimilar Materials" Paragraph in Appendix B in AAMA/NWWDA 101/I.S.2.

3.3 FIELD QUALITY CONTROL

A. Remove and replace components that do not comply with specified requirements.

3.4 ADJUSTING

A. Adjust hardware, and accessories for a tight fit at contact points and weather stripping for smooth operation and weathertight closure. Lubricate hardware and moving parts.

3.5 PROTECTION AND CLEANING

A. Protect curtain wall surfaces from contact with contaminating substances resulting from construction operations. In addition, monitor surfaces adjacent to and below exterior concrete and masonry surfaces during construction for presence of dirt, scum, alkaline deposits, stains, or other contaminants. If contaminating substances do contact the curtain wall surfaces, remove contaminants immediately according to manufacturer's written recommendations.

B. Clean exposed surfaces immediately after installing curtain wall systems. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

C. Clean factory-glazed glass immediately after installing the system. Comply with manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels and clean surfaces.

D. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION

SECTION 08710

DOOR HARDWARE

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 commercial door hardware for the following:

1. Hollow metal framed swinging doors.
2. Cylinders for aluminum swinging doors.

B. Door operating hardware to be supplied by the following:

1. Section 08413, Aluminum Framed Entrances and Storefronts
2. Section 08441 Glazed Aluminum Curtain Wall.

C. Related Sections:

1. Section 08113 Hollow Metal Doors and Frames.

2. Section 08413 Aluminum-Framed Entrances and Storefronts.

3. Section 08441 Glazed Aluminum Curtain Wall.

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.

2. ICC/IBC - International Building Code.

3. NFPA 80 - Fire Doors and Windows.

4. NFPA 101 - Life Safety Code.

5. NFPA 105 - Installation of Smoke Door Assemblies.

6. UL/ULC and CSA C22.2 – Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.

7. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards - A156 Series

2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.

b. Manufacturer of each item.

c. Fastenings and other pertinent information.

d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.

e. Explanation of abbreviations, symbols, and codes contained in schedule.

f. Mounting locations for door hardware.

g. Door and frame sizes and materials.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.

D. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service

representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

E. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum 3 years documented experience installing both standard and electrified builders hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor in good standing by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

1. Scheduling Responsibility: Preparation of door hardware and keying schedules.

D. Source Limitations: Obtain each type and variety of Door Hardware specified in this Section from a single source, qualified supplier unless otherwise indicated.

E. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:

1. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:

a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.

b. Door Closers: Comply with the following maximum opening-force requirements indicated:

1) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.

2. NFPA 101: Comply with the following for means of egress doors:

a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.

b. Thresholds: Not more than 1/2 inch high.

3. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 (neutral pressure at 40" above sill) or UL-10C.

a. Test Pressure: Positive pressure labeling.

F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.

2. Plans for existing and future key system expansion.

3. Requirements for key control storage and software.

4. Installation of permanent keys, cylinder cores and software.

5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Inspect and discuss preparatory work performed by other trades.

2. Review and finalize construction schedule and verify availability of materials.

3. Review the required inspecting, testing, commissioning, and demonstration procedures.

I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door and Frame Preparation: Related Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.

2. Faulty operation of the hardware.

3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

1. Ten years for mortise locks and latches.

2. Five years for exit hardware.

3. Twenty five years for manual surface door closers.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

B. Continuing Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

1. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

a. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

B. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.

1. Acceptable Manufacturers:

a. Bommer Industries (BO).

b. Hager Companies (HA).

c. McKinney Products (MK).

B. Continuous Geared Hinges: ANSI/BHMA A156.26 certified continuous geared hinge with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Provide concealed flush mount (with or without inset), full surface, or half surface, in standard and heavy duty models, as specified in the Hardware Sets. Concealed continuous hinges to be U.L. listed for use on up to and including 90 minute rated door installations and U.L. listed for windstorm components where applicable. Factory cut hinges for door size and provide with removable service power transfer panel where indicated at electrified openings.

1. Acceptable Manufacturers:

a. Bommer Industries (BO).

b. McKinney Products (MK).

c. Pemko Manufacturing (PE).

2.3 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified automatic, self-latching, and manual flush bolts and surface bolts. Manual flush bolts to be furnished with top rod of sufficient length to allow bolt location approximately six feet from the floor. Furnish dust proof strikes for bottom bolts. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

1. Acceptable Manufacturers:

a. Rockwood Manufacturing (RO).

b. Trimco (TC).

B. Door Push Plates and Pulls: ANS/BHMA A156.6 certified door pushes and pulls of type and design specified below or in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.

2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.

3. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

a. Acceptable Manufacturers:
1) Burns Manufacturing (BU).
2) Rockwood Manufacturing (RO).
3) Trimco (TC).

2.4 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

C. Cylinders: Original manufacturer cylinders complying with the following:

1. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.

2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.

3. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.

4. Keyway: Manufacturer’s Standard.

D. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:

1. Removable Cores: Core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware. Provide removable core (small or large format) as specified in Hardware Sets.

E. Patented Cylinders: ANSI/BHMA A156.5, Grade 1, certified cylinders employing a utility patented and restricted keyway requiring the use of patented controlled keys. Provide bump resistant, fixed core cylinders as standard with solid recessed cylinder collars. Cylinders are to be factory keyed where permanent keying records will be established and maintained.

1. Provide a 6 pin multi-level master key system comprised of patented controlled keys and security and high security cylinders operated by one (1) key of the highest level. Geographical exclusivity to be provided for all security and high security cylinders and UL437 certification where specified.

a. Level 1 Cylinders: Provide utility patented controlled keyway cylinders that are furnished with patented keys available only from authorized distribution.

2. Acceptable Manufacturer:

a. Sargent Manufacturing (SA) - Degree Series.

b. Corbin Russwin (RU) – Access 3 Series.

c. Schlage (SC) – Everest 29 Restricted Series.

F. Keying System: Each type of lock and cylinders to be factory keyed. Conduct specified "Keying Conference" to define and document keying system instructions and requirements. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner. Incorporate decisions made in keying conference.

G. Key Quantity: Provide the following minimum number of keys:

1. All Master Key Levels: three (3)

2. Change Keys per Cylinder: Four (4)

3. Construction Keys: Five (5)

4. Construction Control Keys: Two (2)

5. Permanent Control Keys: Two (2)

H. Construction Keying: Provide temporary keyed construction cores where specified. Provide construction master keys in quantity as required by project Contractor. Replace construction cores with permanent cores. Furnish permanent cores for installation as directed under specified "Keying Conference".

I. Key Registration List: Provide keying transcript list to Owner's representative in the proper format for importing into key control software.

J. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.

1. Acceptable Manufacturers:

a. Lund Equipment (LU).

b. MMF Industries (MM).

c. Telkee (TK).

K. Key Control Software: Provide one network version of "Key Wizard" branded key management software package that includes one year of technical support and upgrades to software at no charge. Provide factory key system formatted for importing into “Key Wizard” software.

2.5 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified mortise locksets furnished in the functions as specified in the Hardware Sets. Locksets to be manufactured with a corrosion resistant, stamped 12 gauge minimum formed steel case and be field-reversible for handing without disassembly of the lock body. Lockset trim (including knobs, levers, escutcheons, roses) to be the product of a single manufacturer. Furnish with standard 2 3/4" backset, 3/4" throw anti-friction stainless steel latchbolt, and a full 1" throw stainless steel bolt for deadbolt functions.

1. Acceptable Manufacturers:

a. Corbin Russwin Hardware (RU) – ML2000 Series.

b. Sargent Manufacturing (SA) – 8200 Series.

c. Schlage (SC) – L9000 Series.

B. Lock Trim Design: As specified in Hardware Sets.

C. Knurling: Where required by local code provide knurling or abrasive coating to all levers on doors leading to hazardous areas such as mechanical rooms, etc.

2.6 AUXILIARY LOCKS

A. Mortise Deadlocks, Small Case: ANSI/BHMA A156.5, Grade 1, certified small case mortise type deadlocks constructed of heavy gauge wrought corrosion resistant steel. Steel or stainless steel bolts with a 1" throw and hardened steel roller pins. Deadlocks to be products of the same source manufacturer and keyway as other specified locksets.

1. Acceptable Manufacturers:

a. Corbin Russwin Hardware (RU) - DL4100 Series.

b. Sargent Manufacturing (SA) - 4870 Series.

c. Schlage (SC) - L460 Series.

2.7 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.

2. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.

2. Strikes for Auxiliary Deadlocks: BHMA A156.5.

3. Dustproof Strikes: BHMA A156.16.

2.8 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is not acceptable except in any case where the door light extends behind the device as in a full glass configuration.

5. Flush End Caps: Provide heavy weight impact resistant flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.

6. Vertical Rod Exit Devices: Provide and install interior surface and concealed vertical rod exit devices as Less Bottom Rod (LBR) unless otherwise indicated.

7. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

8. Rail Sizing: Provide exit device rails factory sized for proper door width application.

B. Tube Steel Removable Mullions: ANSI/BHMA A156.3 removable steel mullions with malleable-iron top and bottom retainers and a primed paint finish. Provide keyed removable feature, stabilizers, and mounting brackets as specified in the Hardware Sets. At openings designed for severe wind load conditions due to hurricanes or tornadoes, provide manufacturers approved mullion and accessories to meet applicable state and local windstorm codes.

1. Acceptable Manufacturers:

a. Corbin Russwin Hardware (RU) - 900 Series.

b. Sargent Manufacturing (SA) - 980S Series.

c. Von Duprin (VD) - 9954 Series.

2.9 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Acceptable Manufacturers:

a. Burns Manufacturing (BU).

b. Rockwood Manufacturing (RO).

c. Trimco (TC).

2.10 ARCHITECTURAL SEALS

A. General: Thresholds and gasket seals to be of type and design as specified below or in the Hardware Sets. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

1. Acceptable Manufacturers:

a. Pemko Manufacturing (PE).

b. Reese Enterprises, Inc. (RS).

c. Zero International (ZE).

2.11 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.12 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

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. General finish standard: brushed aluminum.

D. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Frames: Comply with ANSI/DHI A115 series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.
   1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

   1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

   2. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."

C. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. and provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DOOR HARDWARE SCHEDULE

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

B. The supplier is responsible for handing and sizing all products as listed in the door hardware sets. Quantities listed are for each pair of doors, or for each single door.

C. Manufacturer's Abbreviations:
   1. MK - McKinney
   2. PE - Pemko
   3. RF - Rixson
   4. RO - Rockwood
   5. YA - Yale
   6. NO - Norton
   7. SU - Securitron
   8. TC - Trimco
   9. 00 - Other

Hardware Schedule

Set: 1.0

Description: Sgl w/ Storeroom Lock; No Closer

3	Hinge	TA2714	US26D	MK
1	Mortise Lock (storeroom)	TCR6 8805RL K825xCT6LL	626	YA
1	Core	K800	626	YA
1	Kickplate	K1050 10" 4BE CSK	US26D	RO
1	Door Stop	404 (wall) / 441CU (floor)	US26D	RO
3	Silencer	608/609		RO

Set: 2.0

Description: Double w/ Storeroom Lock; No Closer

6	Hinge	TA2714	US26D	MK
1	Mortise Lock (storeroom)	TCR6 8805RL K825xCT6LL	626	YA
1	Core	K800	626	YA
2	Kickplate	K1050 10" 4BE CSK	US26D	RO
1	Door Stop	404 (wall) / 441CU (floor)	US26D	RO
6	Silencer	608/609		RO

END OF SECTION

SECTION 09900

PAINTING AND COATING
(Filed Sub-Bids Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

B. Time, Manner and Requirements for Submitting Sub-Bids:

1. Sub-bids for work under this Section shall be for the complete work and shall be filed in a sealed envelope with the Form for Sub Bid, Bid Bond, DCAMM Eligibility Certificate and Update Statement, at a time and place as stipulated in the "INSTRUCTIONS TO BIDDERS".

2. Each sub-bid submitted for work under this Section shall be on forms furnished herein as required by Section 44F of Chapter 149 of the General Laws, as amended.

C. Sub Sub-Bid Requirements: (None required under this Section.)

D. Reference Drawings: The Work of this Filed Sub-Bid is shown on the following Contract Drawings: G000; G001; A002, A101-5, A201-208, A301-302, A401-402, A 501-502, A701.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Field painting of certain exposed exterior items and surfaces.

2. Field painting of Metal Roof decking, factory primed.

3. Surface preparation for painting.

4. Note: precast concrete, hot-dipped galvanized steel, and aluminum items to remain uncoated beyond shop applied coatings.

B. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 05120 - STRUCTURAL STEEL FRAMING for shop primed structural steel.

2. Section 05500 – MISCELLANEOUS METALS for shop primed metal to be coated. Hot dip galvanized ferrous metal to remain unpainted.

3. Section 08113 - HOLLOW METAL DOORS AND FRAMES for factory primed steel doors and frames.

1.3 DEFINITIONS AND EXTENT

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 refers to low-sheen finish with a gloss range between 20 and 25 when measured at a 60-degree meter.

3. Satin refers to low/medium-sheen finish with a gloss range between 25 and 35 when measured at a 60-degree meter.

4. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.

5. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

B. This Section includes surface preparation and field painting of exposed exterior 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.

2. Exposed items to be painted: doors, door frames, and miscellaneous items, to be determined.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1. Prefinished items include the following factory-finished components:

a. Elevator entrance doors and frames.

b. Elevator equipment.

c. Finished mechanical and electrical equipment, including sprinkler risers and electrical conduit.

d. Plumbing piping.

e. Light fixtures.

2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:

a. Foundation spaces.

b. Furred areas.

c. Pipe spaces.

d. Duct shafts.

e. Elevator shafts.

3. Finished metal surfaces include the following:

   a. Anodized aluminum.

   b. Stainless steel.

   c. Chromium plate.

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.

5. Labels: Do not paint over UL, FMG, or other plates.

1.4 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.

   2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

B. 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 two eight inch by 12 inch Samples for each type of finish coating for Architect's review of color and texture only.

C. Qualification Data: For Applicator.

1.5 QUALITY ASSURANCE

A. 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.

B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

C. Mockups: Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.

1. Architect will select one surface to represent surfaces and conditions for application of each type of coating and substrate.

2. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.

a. After finishes are accepted, Architect will use the surface to evaluate coating systems of a similar nature.

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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work are listed in the Finish Schedule at the end of this Section.

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. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.

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. Provide barrier coats over incompatible primers or remove and reprime.

2. Cementitious Materials: No coating of precast concrete required.

3. 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.

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.

4. Galvanized Surfaces: to remain as coated, grey color, or per colored galvanizing process.

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 continuously 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.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.

2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

3. Provide finish coats that are compatible with primers used.

4. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.

5. Sand lightly between each succeeding enamel or varnish coat.

6. Regardless of coats applied of paint, provide additional coats as needed to obtain satisfactory final result in terms of full coverage on all surfaces to receive paint or coating.

B. 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.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

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.

A. 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.

D. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.

E. Mechanical items to be painted include, but are not limited to, the following:

1. Uninsulated metal piping.

2. Uninsulated plastic piping.

3. Pipe hangers and supports.

4. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

F. Electrical items to be painted include, but are not limited to, the following:

1. Electrical equipment that is indicated to have a factory-primed finish for field painting.

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. 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. The Owner reserves the right to invoke the following test procedure at any time and as often as the Owner deems necessary during the period when paint is being applied:

1. The 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. The Architect 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 PAINT SCHEDULE

A. Schedule: Provide products and number of coats specified. Use of manufacturer's proprietary product names to designate colors, materials, generic class, standard of quality and performance criteria and is not intended to imply that products named are required to be used to the exclusion of equivalent performing products of other manufacturers.

B. Exterior Paint Schedule:

1. Concrete Unit Masonry: for Ground floor exterior concrete masonry unit wall, exposed to view: Low-Luster Acrylic Enamel Finish.

   a. Block Filler: concrete unit masonry block filler

   b. Two finish coats: Acrylic solid enamel, semi-gloss.

2. Full-Gloss Acrylic Enamel Finish: Two finish coats over shop primer:

   a. Primer: Metal primer, touch up surfaces with factory primer

   b. Two finish Coats: Exterior full gloss enamel.

END OF SECTION

SECTION 10140

SIGNAGE

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Code-required panel signage, including but not limited to, accessibility signage, vehicular directional signage, and elevator, mechanical and electrical room signage.

2. Building-mounted identification signs, including custom design wayfinding signage.

3. Cut metal signage for site based building identification signage.

B. Alternates: Not Applicable.

C. Items To Be Installed Only: Not Applicable.

D. Items To Be Furnished Only: Not Applicable.

E. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Division 5 – MISC METALS for framework supporting cut lettering for exterior site based building identification signage.

2. Division 26- ELECTRICAL for backlit and illuminated exit 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. 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.

C. Samples for Verification: For each type of sign, include the following Samples to verify colors selected:

1. Panel Signs: Full-size Samples of each type of sign required.

2. Approved samples will not be returned for installation into Project.

D. Maintenance Data: For signage cleaning and maintenance requirements to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each sign type through one source from a single manufacturer.

B. Regulatory Requirements: Comply with the Massachusetts Architectural Access Board, Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.

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.

PART 2 - PRODUCTS

2.1 PANEL SIGNS

A. General: Provide signs that comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction as indicated. Produce smooth panel sign surfaces constructed to remain flat under installed conditions within tolerance of plus or minus 1/16 inch measured diagonally. Provide the following:

1. Code-Required Signs for Certificate of Occupancy:

a. Type: Photopolymer on acrylic or printed acrylic / aluminum as applicable.

b. Color: Selected from manufacturer’s standard colors including metallic silver, off white, champagne, light gray, dark red, dark green, dark blue, dark bronze, charcoal. White letters on color background.

c. Type Size: As selected.

d. Typeface: As selected.

e. Size: As indicated on the Drawings.

B. 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. Raised-Copy Thickness: Not less than 1/32 inch

C. Symbols of Accessibility: Provide at all accessible parking spaces as part of identification signage.

2.2 PANEL SIGNS, WAYFINDING

A. Provide custom, floor identification signs that comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction. Produce panel sign surfaces constructed to remain flat under installed conditions within tolerance of plus or minus 1/16 inch measured diagonally.

1. Type: Photopolymer on printed aluminum.

2. Color: Selected from manufacturer's standard colors including metallic silver, off white, champagne, light gray, dark red, dark green, dark blue, dark bronze, charcoal.

3. Size: As indicated on the Drawings.

2.3 BUILDING-MOUNTED IDENTIFICATION SIGNAGE

A. Provide separate cast aluminum letters for mounting on brick siding above entry as shown on drawings.

B. Provide anchoring system per manufacturer's recommendations and metal panel system requirements.

2.4 ACCESSORIES

A. Mounting Methods: Use double-sided vinyl tape 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 exterior installations and elsewhere 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.

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 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.

B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using methods recommended by manufacturer for exterior, tamper proof locations.

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 the Design Professional.

END OF SECTION

SECTION 10606

CHAIN LINK SCREEN

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The following specialty items are included under this section.

1. Vinyl Coated Chain Link Screen, located at openings in precast concrete wall panels and entrance gate to storage area at grade level.

1.2 QUALITY ASSURANCE

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication, where possible. Do not delay job progress; allow for trimming and fitting wherever taking field measurements before fabrication might delay work.

1.3 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's specifications, anchor details, and installation instructions. Submit certification that all materials fully comply with specifications and that the vinyl clad coating is warranted against rust and corrosion for 15 years.

B. Shop Drawings: Submit shop drawings for fabrication and installation including plans, elevations, and details of sections and connections. Show anchorage and accessory items.

C. Full Size Panel: One full size panel for a typical bay to be available to view at precast plant. Fabrication of the screens shall not commence until on shop drawings have been approved and typical screen detail is reviewed by architect at plant.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fabric: Commercial quality medium high carbon, hot dipped galvanized steel wire. Zinc coating shall be minimum of .30 ounces per square foot. Vinyl coating (PVC) shall be continuously extrusion bonded (not sprayed or dipped) over the galvanized steel wire by the thermal extrusion bonding process under pressure to 5,000 psi. The wire shall be vinyl-clad before weaving and shall be free and flexible at all joints.

1. Wire size - 9 gauge
2. Mesh size - 1-1/2 inch
3. Selvage at edges - Knuckled
4. Color - Black

B. Framework: Vertical, horizontal and diagonal members shall be 1 5/8 inch outside diameter, schedule 40 hot dipped galvanized pipe. Zinc coating shall be a minimum of 1.8 ounces per square foot of the total coated surface.

1. Finish: Black vinyl coating.

C. Accessories: All accessories shall be vinyl coated to match color of fabric. Fabric ties shall be min. 9-

gauge thickness.

PART 3 - EXECUTION

3.1 FABRICATION

A. Cope pipe connections accurately to form tight joints. Continuously weld connections and grind joints smooth. Touch up galvanized coating with galvanizing repair paint.

B. Comply with manufacturer's specifications and recommendations for the installation of chain link fabric.

3.2 INSTALLATION

A. Set units plumb, level and true to line. Anchor securely in place with non-corrosive expansion bolts. Separate corrodible metal surfaces form sources of corrosion or electrolytic action at points of contact with other materials.

B. Provide all protective treatment and other precautions required through the remainder of the construction period, to ensure that specialty units will be without damage or deterioration (other than normal weathering) at time of acceptance.

END OF SECTION

SECTION 10820

GRILLES AND SCREENS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF WORK

A. This work shall consist of providing mesh screening, including installation accessories and attachment to precast structure (see Alternates).

1.3 QUALIFICATIONS

A. Work specified herein shall be performed by and be the responsibility of the Installation Contractor authorized, approved and qualified by the manufacturer of materials used; having necessary equipment and facilities to fulfill requirements of the manufacturer and this section.

1.4 SUBMITTALS

A. Manufacturer's Data: Submit specifications, installation instructions and general recommendations by the manufacturer of architectural mesh screening.

B. Shop Drawings: Submit shop drawings showing dimensioned elevations, large scale details of all edge terminations, fastening details, and interface with lighting fixtures, mullions, and other construction to be encountered..

C. Samples: Submit 12” x 16” sample of selected screen.

1.5 DELIVERY AND STORAGE

A. Deliver materials to project site in sealed, original packages or containers bearing name and brand of manufacturer.

B. Store materials in single place designated by Owner and/or Consultant, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures and humidity. Keep storage place neat and clean.

C. Deliver and store products in packaging that ensures products will not be cracked or otherwise damaged.

1.6 JOB CONDITIONS

A. Field Measurements: Verify openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.7 COORDINATION

A. Coordinate installation of anchorages for mesh screens. Furnish setting drawings, templates, and direction for installing anchorages. Deliver such items to Project site in time for installation.

1.8 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace mesh systems that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, the following:

1. Failure to meet performance requirements.

2. Structural failures including excessive deflection across span.

3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

B. Warranty Period: One year from date of Substantial Completion.

C. Warranty Period for Metal Finishes: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 EXTERIOR MESH SCREEN SYSTEM

A. Basis of Design Product: Subject to compliance with requirements, provide HUDSON stainless steel mesh, by Cambridge Architectural Mesh. 82% open area, 1.46 lbs/sq.ft., with a maximum width of 240", per www.CambridgeArchitectural.com, or comparable product by one of the following:

1. Kovach Building enclosures, Inc.

2. Bunting Architectural Metals, Inc.

B. FASTENERS

1. Fastener Material: Type 304 stainless steel fasteners and angle iron as shown on the drawings.

2. Fasteners for Anchoring to structure: select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated item to other types of construction, and as shown on the Drawings.

PART 3 - EXECUTION

3.1 CONDITION OF SUBSTRATE

A. Examine the substrate and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of ornamental metal. Do not proceed with the work until unsatisfactory conditions have been corrected and approved by the manufacturer's representative.

1. Installation of products constitutes Installers and Manufacturer's acceptance of existing construction.

3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's instructions, except where more stringent requirements are shown or specified, and except where project conditions require extra precautions or provisions to ensure satisfactory performance of the work.

B. Provide anchorage devices, fasteners, and structural angles where needed to secure screens to precast substrate. Perform cutting, drilling, and fitting required to install screens. Set products accurately in location, alignment, and elevation; measured from established lines and levels.

C. Do not cut or abrade finishes that cannot be completely restored in the field.

3.3 CLEANING

A. Upon completion of work, clean mesh screen as directed by manufacturer.

B. Correct all defective or damaged work.

C. Upon completion, or at such other times as directed, remove all surplus materials, cartons, rubbish and debris resulting from these operations and legally dispose of off-site.

3.4 PROTECTION

A. Provide protection to ensure that work will be without damage or deteriorations at time of final acceptance.

END OF SECTION

SECTION 14240

HYDRAULIC ELEVATORS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.2 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. One hydraulic passenger elevator, four stop, 38 foot travel distance, gurney sized. Pit depth of 4'-0". Elevator to meet stretcher requirements as defined by 524 CMR 17.4(1) (c) and 17.4(1)(d).

2. All required brackets, inserts, and accessories, including steel elevator pit ladder.

B. Items To Be Furnished Only: Furnish the following items for installation by the designated Sections

1. Section 03 40 00 – PRECAST CONCRETE:

a. Elevator rail bracket inserts.

C. Related Work: The following items are not included in this Section and are specified under the designated Sections:

1. Section 34000 - P R E C A S T CONCRETE for lintels, sleeves, anchors, inserts, plates and similar items for elevators.

2. Section 51200 - STRUCTURAL STEEL FRAMING for the hoist beams, attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.

3. Section 55000 - METAL FABRICATIONS for miscellaneous framing and supports for hoisting machines, and for elevator door sills, cants in hoistway made from sheet steel.

4. Division 26 - ELECTRICAL for electrical service for elevators to and including disconnect switches at machine room door and telephone wiring to elevator.

1.3 DEFINITIONS

A. Definitions in ASME A17.1 apply to work of this Section.

B. Defective Elevator Work: Operation or control system failures; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe

conditions; the need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.

1.4 SUBMITTALS

A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for the following:

1. Car enclosures and hoistway entrances.

2. Operation, control, and signal systems.

B. Shop Drawings: Show plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment and signals. Include large-scale layout of car control station and standby power operation control panel. Indicate variations from specified requirements, maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

C. Samples for Verification: For exposed finishes of cars, hoistway doors and frames, and signal equipment; samples or photos to be provided.

D. Qualification Data: For Installer.

E. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

F. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

G. Warranty: Special warranty specified in this Section.

H. Continuing Maintenance Proposal: Service agreement specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer or manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain elevators through one source from a single manufacturer.

1. Provide major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cabs, and entrances, manufactured by a single manufacturer.

C. Regulatory Requirements: Comply with ASME A17.1 and Massachusetts Elevator Code.

D. Accessibility Requirements: Comply with Section 4.10 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG) and the Massachusetts Architectural Access Board.

E. Fire-Rated Hoistway Entrance Assemblies: Door and frame assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to

authorities having jurisdiction, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging.

B. Store materials, components, and equipment off of ground, under cover, and in a dry location. Handle according to manufacturer's written recommendations to prevent damage, deterioration, or soiling.

1.7 COORDINATION

A. Coordinate installation of sleeves, block outs, and items that are embedded in concrete or masonry for elevator equipment. Furnish templates and installation instructions and deliver to Project site in time for installation.

B. Furnish well casing and coordinate delivery with related excavation work.

C. Coordinate sequence of elevator installation with other work to avoid delaying the Work.

D. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders, sumps, and floor drains in pits; entrance subsills; and electrical service, electrical outlets, lights, and switches in pits and machine rooms.

1.8 WARRANTY

A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to repair, restore, or replace defective elevator work within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide one year's full maintenance service by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1. Include 24-hour-per-day, 7-day-per-week emergency callback service.

B. Continuing Maintenance Proposal: Provide a continuing maintenance proposal from Installer to Owner, in the form of a standard one-year maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Otis Elevator Co.

2. Schindler Elevator Corp.

3. ThyssenKrupp Elevator.

2.2 PASSENGER ELEVATORS

A. Elevators: Basis of Design: ThyssenKrupp Elevator – Endura Twinpost above-ground 3-stage

1. Type: Holeless.

2. Two jacks, one at each side.

3. Rated Load: 4000 lb.

4. Rated Speed: 125 fpm up 150 fpm down.

5. Operation System: Selective collective automatic operation.

6. Auxiliary Operations:
   a. Battery power return to ground floor.
   b. Automatic dispatching of loaded car.
   c. Nuisance call cancel.

7. Car Enclosures: As follows:
   a. Inside Width: 7’-8” min clear.
   b. Inside Depth: 5’-5” min clear.
   c. Inside Height: 7’-4”.
   d. Front Walls: Stainless steel.
   e. Car Fixtures: Satin stainless steel.
   f. Side and Rear Wall Panels: Plastic Laminate –chosen from manufacturer standard colors.
   g. Door Faces (Interior): Stainless steel.
   h. Door Sills: Aluminum.
   i. Ceiling: LED downlights with powder coated painted finish – color chosen by architect.
   j. Handrails: stainless steel, at side and rear walls.
      Floor: ¼” stainless steel non-skid diamond plate.

8. Hoistway Entrances: As follows:
   a. Width: 48 in. minimum.
   b. Height: 7’-0”.
   c. Type: Center opening sliding.
   d. Frames: stainless steel.
   e. Doors: Stainless steel.
      Sills: Aluminum.

9. Hall Fixtures: #4 Stainless steel.

10. Additional Requirements: As follows:
    a. Provide inspection certificate in each car, mounted under acrylic cover with satin stainless-steel frame.
    b. Provide protective blanket hooks in all cars and two complete sets of full-height blankets.
    c. Provide all necessary warning signage required by local and state codes.

2.3 SYSTEMS AND COMPONENTS

A. General: Provide manufacturer's standard elevator systems. Where components are not otherwise indicated, provide standard components published by manufacturer as included in standard pre-engineered elevator systems and as necessary for complete system.

B. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations. Provide the following:

1. Submersible pump, with submersible squirrel-cage induction motor, suspended inside oil tank from vibration isolation mounts.

2. Provide motor with solid-state starting.

C. Hydraulic Silencers: Provide hydraulic silencer containing pulsation-absorbing material in a blowout-proof housing at pump unit.

D. Piping: Provide size, type, and weight piping recommended by manufacturer, and provide flexible connectors to minimize sound and vibration transmissions from power unit.

1. Provide dielectric couplings at cylinder units.

2. Casing for Underground Piping: PVC pipe complying with ASTM D 1785, joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.

E. Hydraulic Fluid: Nontoxic, readily biodegradable, fire-resistant fluid made from vegetable oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives. Hydraulic fluid is approved by elevator manufacturer for use with elevator equipment.

F. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work where installation of devices is specified in another Section.

G. Car Frame and Platform: Welded steel units.

H. Guides: Provide either roller guides or sliding guides at top and bottom of car and counterweight frames. If sliding guides are used, provide guide-rail lubricators or polymer-coated, nonlubricated guides.

I. Hall & Car station light fixtures: provide vandal resistant fixtures.

2.4 OPERATION SYSTEMS

A. General: Provide manufacturer's standard microprocessor operation system for each elevator as necessary to provide type of operation system indicated.

B. Single-Car Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:

1. Emergency Operation: On activation of smoke alarm, car is returned to a designated floor and parked with doors open.

2. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight can be adjusted.

C. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.

1. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at car control stations. Key is removable in both positions.

2. Car-to-Lobby Feature: Feature, activated by keyswitch at main lobby that causes car to return immediately to lobby and open doors for inspection. On deactivation by keyswitch, calls registered before keyswitch activation are completed and normal operation is resumed.

2.5 DOOR REOPENING DEVICES

A. Infrared Array: Provide door reopening devices with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more of the light beams shall cause doors to stop and re-open.

2.6 FINISH MATERIALS

A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.

D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

E. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.

2.7 HOISTWAY ENTRANCES

A. General: Provide manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Provide frame size and profile to coordinate with hoistway wall construction.

2.8 SIGNAL EQUIPMENT

A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with long-life incandescent lamps and acrylic or other permanent, nonyellowing translucent plastic diffusers or LEDs.

B. Car Control Stations: Provide manufacturer's standard recessed car control stations. Mount in return panel adjacent to car door, unless otherwise indicated.

C. Emergency Communication System: Provide system that complies with ASME A17.1 and the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." On activation, system dials preprogrammed number of monitoring station and identifies elevator location to monitoring station. System provides two-way voice communication without using a handset and provides visible signals that indicate when system has been activated and when monitoring station has responded. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

D. Firefighters' Two-Way Telephone Communication Service: Provide flush-mounted cabinet in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Division 26 - ELECTRICAL.

E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car control station. Also provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served.

1. Include travel direction arrows if not provided in car control station.

F. Hall Push-Button Stations: Provide one hall push-button station at each landing for each single elevator or group of elevators, but not less than one station for each four elevators in a group.

G. Car Lanterns: Units with illuminated Up/Down arrows

H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

1. At manufacturer's option, audible signals may be placed on car.

I. Corridor Call Station Pictograph Signs: Provide signs matching hall push-button stations, with text and graphics, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station, unless otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.

1. For the record, prepare a written report, endorsed by Installer, listing dimensional discrepancies and conditions detrimental to performance or indicating that dimensions and conditions were found to be satisfactory.

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

3.2 INSTALLATION

A. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.

B. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS standards for workmanship and for qualifications of welding operators.

C. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts designed to effectively prevent transmission of vibrations to structure and thereby eliminate sources of structure-borne noise from elevator system.

D. Install piping above the floor, where possible. Where not possible, install underground piping in Schedule 40 PVC pipe casing assembled with solvent-cemented fittings.

E. Lubricate operating parts of systems as recommended by manufacturers.

F. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

G. Leveling Tolerance: 1/4 inch, up or down, regardless of load and direction of travel.

H. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

I. Locate hall signal equipment for elevators as follows, unless otherwise indicated:

1. Place hall lanterns either above or beside each hoistway entrance.

2. Mount hall lanterns at a minimum of 72 inches above finished floor.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting use (either temporary or permanent) of elevators, perform acceptance tests as recommended by ASME A17.1 and by governing regulations and agencies.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times tests are to be performed on elevators.

3.4 PROTECTION

A. Temporary use of installed elevator during construction is not allowed.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate elevator.

B. Check operation of elevator with Owner's personnel present and before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

END OF SECTION

SECTION 15126

SPLIT-SYSTEM AIR-CONDITIONERS
(Filed sub-Bids Required)

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 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: P001, P100, P101, P102, P103, P104.

B. Sub-sub Bids are not required for this trade.

1.3 RELATED DOCUMENTS

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

1.4 SUMMARY

A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

1.6 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.9 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period:

a. For Compressor: Five year(s) from date of Substantial Completion.
b. For Parts: One year(s) from date of Substantial Completion.
c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements.

2.2 INDOOR UNITS

A. Concealed Evaporator-Fan Components:

1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
2. Insulation: Faced, glass-fiber duct liner.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 210/240.
4. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
5. Fan Motors:

    a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
    b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
    c. Three-phase, permanently lubricated, ball-bearing motors with built-in thermal-overload protection.
    d. Wiring Terminations: Connect motor to chassis wiring with plug connection.

6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
7. Filters: 1 inch thick, in fiberboard frames
8. Condensate Drain Pans:

    a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.

        1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
        2) Depth: A minimum of 2 inches.

    b. Single-wall, stainless-steel sheet.
    c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.

        1) Minimum Connection Size: NPS 1.

    d. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

2.3 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

    a. Compressor Type: Scroll or reciprocating.
    b. One-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
    c. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 210/240.
3. Fan: Aluminum-propeller type, directly connected to motor.
4. Motor: Permanently lubricated, with integral thermal-overload protection.
5. Low Ambient Kit: Permits operation down to 0 deg F.

2.4 ACCESSORIES

A. Thermostat: Low voltage with subbase to control compressor and evaporator fan with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection including auto setting.

2.5 CAPACITIES AND CHARACTERISTICS

A. Refer to drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounted, compressor-condenser components on equipment supports specified inSection 077200 "Roof Accessories."Section 07720 "Roof Accessories."Anchor units to supports with removable, cadmium-plated fasteners.

D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

1. Remote, Water-Cooled Condenser Connections: Comply with requirements specified in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties." Connect hydronic piping to supply and return connections with shutoff-duty valve and union or flange on the supply connection and with throttling-duty valve and union or flange on the return connection.

B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

C. Duct Connections: Duct installation requirements are specified in Section 233113 "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply [and return] ducts to split-system air-conditioning units with flexible duct connectors. Flexible duct connectors are specified in Section 233300 "Air Duct Accessories."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

D. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

A. [Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 15126

SECTION 15239

PROPELLER UNIT HEATERS
(Filed Sub-Bids Required)

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 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: P001, P100, P101, P102, P103, P104.

B. Sub-sub Bids are not required for this trade.

1.3 RELATED DOCUMENTS

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

1.4 SUMMARY

A. Section includes propeller unit heaters with electric-resistance heating coils.

1.5 DEFINITIONS

A. CWP: Cold working pressure.

B. PTFE: Polytetrafluoroethylene plastic.

C. TFE: Tetrafluoroethylene plastic.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For propeller unit heaters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements.

1.

2.2 DESCRIPTION

A. Assembly including casing, coil, fan, and motor in **horizontal** discharge configuration with adjustable discharge louvers.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 2021.

D. Comply with UL 823.

2.3 HOUSINGS

A. Finish: Manufacturer's **standard** baked enamel applied to factory-assembled and - tested propeller unit heaters before shipping.

B. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

2.4 COILS

A. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch . Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F at any point during normal operation.

1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.

2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

2.5 FAN AND MOTOR

A. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

B. Motor: Permanently lubricated. Comply with requirements in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.6 CONTROLS

A. Control Devices:
1. **Unit**-mounted thermostat.

2.7 CAPACITIES AND CHARACTERISTICS

A. As scheduled on drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical connections to verify actual locations before unit-heater installation.

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

3.2 INSTALLATION

A. Install propeller unit heaters to comply with NFPA 90A.

B. Install propeller unit heaters level and plumb.

C. Suspend propeller unit heaters from structure with all-thread hanger rods and **elastomeric hangers**.

D. Install wall-mounted thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

3.3 CONNECTIONS

A. Ground equipment according to Div 26.

B. Connect wiring according to Div 26.

3.4 ADJUSTING

A. Adjust initial temperature set points.

END OF SECTION 15239

SECTION 15300

REFRIGERANT PIPING
(Filed Sub-Bids Required)

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 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: P001, P100, P101, P102, P103, P104.

B. Sub-sub Bids are not required for this trade.

1.3 RELATED DOCUMENTS

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

1.4 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.5 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig .
2. Suction Lines for Heat-Pump Applications: 535 psig .
3. Hot-Gas and Liquid Lines: 535 psig .

1.6 ACTION SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:

1. Thermostatic expansion valves.
2. Filter dryers.
3. Pressure-regulating valves.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment. Coordinate all pipe sizes, insulation and routing with architectural elements, walls, floors, etc.…

1. Shop Drawing Scale: 1/4 inch equals 1 foot.
2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

1.7 INFORMATIONAL SUBMITTALS

A. Field quality-control test reports.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.9 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.10 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type K or L.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8.

2.2 VALVES AND SPECIALTIES

A. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F.
6. Reverse-flow option (for heat-pump applications).
7. End Connections: Socket, flare, or threaded union.
8. Working Pressure Rating: 700 psig.

B. Permanent Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Maximum Pressure Loss: 2 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 240 deg F.

2.3 REFRIGERANTS

A. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

A. Hot-Gas and Liquid Lines, Copper, Type L, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.
2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

B. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

3.3 PRE-INSTALLTION CONFERENCE

A. At least 10 days prior to installation of the electrical, mechanical, plumbing & fire protection components within the precast superstructure, the contractor shall conduct a meeting with the Owner’s representative, resident engineer and Contractor’s representatives to review and to discuss the methods and procedures to achieve the quality installation as specified under “Installation”. The contractor shall send a preinstallation conference agenda to all attendees 5 days prior to the schedule date of the conference.

B. The contractor shall require responsible representatives or every party who is concerned with the concrete work to attend the conference, including but not limited to the following: Contractor's superintendent

a. Contractor responsible for field quality control.
b. Electrical/Fire Protection/Plumbing subcontractor.
c. Electrical/Fire Protection/Plumbing Foreman.

C. Minutes of the meeting shall be recorded, typed and printed by the contractor and distributed to all parties concerned within 5 days of the meeting. One copy of the minutes shall also be transmitted to the following for information purposes:

a. Owner's representative
b. Resident engineer
c. Consultant engineer

3.4 PIPING INSTALLATION

A. No installation of any MEP/FP shall commence until coordination plans indicating proposed routings, locations, mountings and similar information submitted and reviewed. No installation shall be allowed until preinstallation meetings have been conducted.

B. Contractor shall install conduit, branch circuitry, home runs, risers and all other electrical components at locations and in a manner that they will not be subject to damage by vehicles including and not limited to vehicles bumpers.

C. Branch conduit to shall be ceiling mounted.

D. Contractor shall install conduit, branch circuitry, home runs, risers and all other electrical components in a neat workmanship manner at locations and routes that do not visually detract from the garage aesthetics with attention to walls, stairs, lobbies, ceilings areas at stair and stair/elevator towers and areas subject to pedestrian traffic.

E. Installations shall be located and installed in such a manner to minimize the potential for moisture related deterioration under precast floor joints with joint sealants.

F. No electrified fixtures, lamps etc… shall be installed at ceiling locations between precast tee stems with tee to tee joints. No horizontal conduit runs shall be installed parallel to precast tee to tee joints between tee stems with tee to tee joints.

G. No conduit shall be allowed to be mounted at or on an inverted “T” beam

H. All conduit shall be mounted tight against precast elements; no suspended conduit allowed.

I. Contractor shall utilize designated vertical chases as shown on the drawings or as approved by the Owner for ALL vertical risers.

J. ALL conduit routed to a wall or column mounted device/equipment shall be routed up to the ceiling to the ceiling mounted branch circuitry.

K. Any fixture, conduit, circuit that does not comply or is a zone subject to vehicular damage shall be relocated at no cost to the owner.

L. MEP/FP material installed prior to the review of coordination drawings and the distribution of accepted preinstallation coordination meeting minutes shall be subject to removal and reinstallation at routes and locations designated by the Owner, Owner’s Project Manager and/or the Engineer.

M. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

N. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

O. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

P. Install piping to permit valve servicing.

Q. Install piping at indicated slopes.

R. Install piping free of sags and bends.

S. Install fittings for changes in direction and branch connections.

T. Install piping to allow application of insulation.

U. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

V. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

W. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

X. Install engineered soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

Y. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

Z. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

AA. Install refrigerant piping according to ASHRAE 15.

BB. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

CC. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

DD. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

EE. Install piping adjacent to machines to allow service and maintenance.

FF. Install piping free of sags and bends.

GG. Install fittings for changes in direction and branch connections.

HH. Select system components with pressure rating equal to or greater than system operating pressure.

II. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

JJ. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels if valves or equipment requiring maintenance is concealed behind finished surfaces.

KK. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

LL. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

MM. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

NN. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

OO. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."

PP. Install sleeves for piping penetrations of walls, ceilings, and floors.

QQ. Install sleeve seals for piping penetrations of concrete walls and slabs.

RR. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.5 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.6 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 60 inches ; minimum rod size, 1/4 inch .
2. NPS 5/8 : Maximum span, 60 inches ; minimum rod size, 1/4 inch .
3. NPS 1 : Maximum span, 72 inches ; minimum rod size, 1/4 inch .

D. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 2 : Maximum span, 10 feet ; minimum rod size, 3/8 inch .

E. Support multifloor vertical runs at least at each floor.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

    a. Fill system with nitrogen to the required test pressure.
    b. System shall maintain test pressure at the manifold gage throughout duration of test.
    c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
    d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.8 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

END OF SECTION 15300

SECTION 15301

SPRINKLER AND STANDPIPE PIPING

PART 1 - GENERAL

1.01 REFERENCES

A. NFPA 14 - Standard for the Installation of Standpipe and Hose Systems.

1.02 SUBMITTALS

A. Product Data:

1. Catalog sheets and specifications indicating manufacturer name, type, applicable reference standard, schedule, or class for specified pipe and fittings.
2. Material Schedule: Itemize pipe and fitting materials for each specified application in Pipe and Fittings Schedule in Part 3 of this Section. Where optional materials are specified indicate option selected.

1.03 PRE-INSTALLATION CONFERENCE (FOR ALL MEP/FP TRADE CONTRACTORS)

A. Installation of MEP/FP systems within the superstructure of the parking garage shall not proceed until after the conclusion and distribution of the pre-installation meeting minutes.

B. At least 10 days prior to installation of the electrical, mechanical, plumbing & fire protection components within the precast superstructure, the contractor shall conduct a meeting with the Owner's representative, resident engineer and Contractor's representatives to review and to discuss the methods and procedures to achieve the quality installation as specified under "Installation". The contractor shall send a pre-installation conference agenda to all attendees 5 days prior to the schedule date of the conference.

C. The contractor shall require responsible representatives or every party who is concerned with the concrete work to attend the conference, including but not limited to the following:

1. Contractor's superintendent
2. Contractor responsible for field quality control.
3. Electrical/Fire Protection/Plumbing subcontractor
4. Electrical/Fire Protection/Plumbing Foreman

D. Minutes of the meeting shall be recorded, typed and printed by the contractor and distributed to all parties concerned within 5 days of meeting. One copy of the minutes shall also be transmitted to the following for informational purposes:

1. Owner's representative
2. Resident engineer
3. Consultant Engineer

PART 2 - PRODUCTS

2.01 STEEL PIPE AND FITTINGS

A. Steel Pipe for Threading: Standard weight, Schedule 40, black or galvanized; ASTM A 53 or ASTM A 135.

B. Steel Pipe for Roll Grooving: Standard weight, Schedule 10 or 40, black or galvanized; ASTM A 53 or ASTM A 135.

C. Cast Iron Fittings:

1. Drainage Pattern, Threaded: ASME B16.12.
2. Steam Pattern, Threaded: ASME B16.4.

a. Standard Weight: Class 125.
b. Extra Heavy Weight: Class 250.

3. Flanged Fittings and Threaded Flanges: ASME B16.1.

a. Standard Weight: Class 125.
b. Extra Heavy: Class 250.

D. Unions: Malleable iron, 250 lb class, brass to iron or brass to brass seats.

E. Couplings: Same material and pressure rating as adjoining pipe, conforming to standards for fittings in such pipe. Use taper tapped threaded type in screwed pipe systems operating in excess of 15 psig.

F. Nipples: Same material and strength as adjoining pipe, except nipples having a length of less than one inch between threads shall be extra heavy.

2.02 COUPLINGS AND FITTINGS FOR GROOVED END PIPE

A. Couplings: Victaulic Co.'s FireLock EZ Style 009H or equal.

B. Fittings: By same manufacturer as couplings, having pressure ratings equal to or greater than couplings. Comply with the following standards:

1. Steel: ASTM A 53 or A 106, Grade B.
2. Malleable Iron: ASTM A 47.
3. Ductile Iron: ASTM A 536.

2.03 BOLTED MECHANICAL BRANCH CONNECTION

A. Victaulic Co.'s 920 Mechanical T.

2.04 JOINING AND SEALANT MATERIALS

A. Thread Sealant:

1. LA-CO Industries' Slic-Tite Paste with Teflon.
2. Loctite Corp.'s No. 565 Thread Sealant.
3. Thread sealants for potable water shall be NSF approved.

B. Joint Packing:

1. Oiled Oakum: Manufactured by Nupak of New Orleans, Inc., 931 Daniel St., Kenner, LA 70062, (504) 466-1484.

C. Gaskets For Use With Ductile Iron Water Pipe: Synthetic rubber rings (molded or tubular): Clow Corp.'s Belltite, Tyler Pipe Industries Inc.'s Ty-Seal, or U.S. Pipe and Foundry Co.'s Tyton.

D. Flange Gasket Material:

1. For Use With Cold Water: 1/16 inch thick rubber.

E. Gaskets For Use With Grooved End Pipe and Fittings: Type and materials as recommended and furnished by the fitting manufacturer, for the service of piping system in which installed.

F. Anti-Seize Lubricant: Bostik Inc.'s Never Seez or Dow Corning Corp.'s Molykote 1000.

2.05 PACKING MATERIALS FOR BUILDING CONSTRUCTION PENETRATIONS

A. Oiled Oakum: Manufactured by Nupak of New Orleans, Inc., 931 Daniel St., Kenner, LA 70062, (504)466-1484.

B. Mechanical Modular Seals: Thunderline Corp.'s Link Seal wall and floor seals designed for the service of piping system in which installed.

2.06 PIPE SLEEVES

A. Type A: Schedule 40 steel pipe.

B. Type B: No. 16 gage galvanized sheet steel.

C. Type D: No. 16 gage galvanized sheet steel with 16 gage sheet steel metal collar rigidly secured to sleeve. Size metal collars as required to span a minimum of one cell or corrugation, on all sides of the rough opening thru the metal deck.

2.07 FLOOR, WALL AND CEILING PLATES

A. Cast Brass: Solid type with polished chrome plated finish, and set screw.

1. Series Z89 by Zurn, 929 Riverside Drive, Grosvenordale, CT 06255, (800) 243-1830.
2. Model 127XXXX by Maguire Mfg., Cheshire CT 06410, (203) 699-1801.

B. Stamped Steel: Split type, polished chrome plated finish, with set screw.

1. Figures 2 and 13 by Anvil International, Portsmouth, NH 03802, (603) 422-8000.

C. Cast Iron or Malleable Iron : Solid type, galvanized finish, with set screw:

1. Model 395 by Anvil International, Portsmouth, NH 03802, (603) 422-8000.
2. Model 900-016XX by Landsdale International, Westville, NJ 08093, (800) 908-0523.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install piping at approximate locations indicated, and at maximum height.

B. Install piping clear of door swings, and above sash heads.

C. Make allowances for expansion and contraction.

D. Allow for a minimum of one inch free air space around pipe or pipe covering, unless otherwise specified.

E. Install horizontal piping with a constant pitch, and without sags or humps.

F. Install vertical piping plumb.

G. Use fittings for offsets and direction changes.

H. Cut pipe and tubing ends square; ream before joining.

I. Threading: Use American Standard Taper Pipe Thread Dies.

3.02 FIRE STANDPIPE PIPING SYSTEM

A. Install piping to be completely drainable.

3.03 PIPE JOINT MAKE-UP

A. Threaded Joint: Make up joint with a pipe thread compound applied in accordance with manufacturer's printed application instructions for the intended service.

B. Flanged Pipe Joint:

1. Install threaded companion flanges on steel pipe; flanges on galvanized pipe are not required to be galvanized.
2. Provide a gasket for each joint.
3. Coat bolt threads and nuts with anti-seize lubricant before making up joint.

C. Grooved Pipe Joint: Roll groove pipe ends, make up joint with grooved end fittings and couplings, in conformance with the manufacturer's printed installation instructions.

1. Cut grooved end piping is not acceptable.

D. Mechanical Joint: Make up joint in conformance with the manufacturer's printed installation instructions, with particular reference to tightening of bolts.

3.04 PIPING PENETRATIONS

A. Sleeve Schedule: Unless otherwise shown, comply with the following schedule for the type of sleeve to be used where piping penetrates wall or floor construction:

	CONSTRUCTION	SLEEVE TYPE
1.	Frame construction.	None Required

2.	Foundation walls.	A*
3.	Non-waterproof interior walls.	B*
4.	Non-waterproof interior floors on metal decks.	D*
5.	Non-waterproof interior floors not on metal decks.	B*
6.	Floors not on grade having a floor drain.	A
7.	Floors over mechanical equipment, steam service, machine, and boiler rooms.	A
8.	Floors finished or to be finished with latex composition or terrazzo, and on metal decks.	D*
9.	Floors finished or to be finished with latex composition or terrazzo, and not on metal decks.	A
10.	Earth supported concrete floors.	None Required
11.	Exterior concrete slabs on grade.	A
12.	Fixtures with floor outlet waste piping.	None Required
13.	Metal roof decks.	C
14.	Non-metal roof decks.	A
15.	Waterproof floors on metal decks.	D
16.	Waterproof floors not on metal decks.	A
17.	Waterproof walls.	A

*Core drilling is permissible in lieu of sleeves where marked with asterisks.

B. Diameter of Sleeves and Core Drilled Holes:

1. Unless otherwise specified, size holes thru floors and walls in accordance with the through penetration fire stopping system being used.
2. Size holes thru exterior walls or waterproofed walls above inside earth or finished floors, and exterior concrete slabs in accordance with the following:

   a. Uninsulated (Bare) Pipe: Inside diameter of sleeve or core drilled hole 1/2 inch greater than outside diameter of pipe, unless otherwise specified.
   b. Insulated Pipe: Inside diameter of sleeve or core drilled hole 1/2 inch greater than outside diameter of insulation, unless otherwise specified.
   c. Mechanical Modular Seals: Size holes in accordance with the manufacturer's recommendations.

3. Size holes for sprinkler and fire standpipe piping in accordance with NFPA 13.

C. Length of Sleeves (except as shown otherwise on Drawings):

1. Walls and Partitions: Equal in length to total finished thickness of wall or partition.
2. Floors, Finished: Equal in length to total finished thickness of floor and extending 1/2 inch above the finished floor level, except as follows:

    a. In furred spaces at exterior walls, extend sleeve one inch above the finished floor level.

3. Exterior Concrete Slabs: Equal in length to total thickness of slab and extending 1/2 inch above the concrete slab.
4. Roofs: Equal in length to the total thickness of roof construction, including insulation and roofing materials, and extending one inch above the finished roof level.

D. Packing of Sleeves and Core Drilled Holes:

1. Unless otherwise specified, pack sleeves or cored drilled holes in accordance with Section 078400 - FIRESTOPPING.
2. Pack sleeves in exterior walls or waterproofed walls above inside earth or finished floors with oakum to within 1/2 inch of each wall face, and finish both sides with Type 1C (one part) sealant. See Section 079200.

    a. Mechanical modular seals may be used in lieu of packing and sealant for sleeves and core drilled holes.

3. Pack sleeves in exterior concrete slabs with oakum to full depth, and within 1/2 inch of top of sleeve and finish the remainder with sealant. See Section 079200.

    a. Sealant Types:

        1) Piping Conveying Materials up to 140 degrees F other than Motor Fuel Dispensing System Piping: Type 1C (one part).

    b. Mechanical modular seals may be used in lieu of packing and sealant for sleeves and core drilled holes.

E. Weld metal collars of Type C and D sleeves to the upper surface of the metal deck. Seal voids under the metal collar as recommended by the manufacturer of the metal deck.

3.05 FLOOR, WALL AND CEILING PLATES

A. Install plates for exposed uninsulated piping passing thru floors, walls, ceilings, and exterior concrete slabs as follows:

1. Piping 2 Inch Size and Smaller In Finished Spaces:

    a. Solid Type: Chrome plated cast brass construction with set screw.
    b. Split Type: Chrome plated stamped steel construction with set screw.

2. Piping over 2 inch size In Finished Spaces, and Piping in Unfinished Spaces:

    a. Solid Type: Galvanized cast iron construction with set screw.
    b. Split Type: Chrome plated stamped steel construction with set screw.

3. Piping in Unfinished Spaces (Including Exterior Concrete Slabs): Solid type, galvanized, cast iron or malleable iron construction.
4. Fasten plates with set screws.
5. Plates are not required in pipe shafts or furred spaces.

3.06 PIPE AND FITTING SCHEDULE

A. Where options are given, choose only one option for each piping service. No deviations from the selected option will be allowed.

B. Fire Standpipe and Sprinkler:

1. Option No. 1: Standard weight black steel pipe, with standard weight cast iron fittings, and threaded joints.
2. Option No. 2: Standard weight black steel pipe, with roll grooved ends, grooved pipe fittings, and couplings.

END OF SECTION

SECTION 15310

FIRE PROTECTION PIPE HANGERS AND SUPPORTS

PART 1 - GENERAL

1.01 SUBMITTALS

A. Shop Drawings:

1. Details of trapeze hangers and upper hanger attachments for piping 4 inches in diameter and over. Include the number and size of pipe lines to be supported on each type of trapeze hanger.
2. Drawings identifying seismic locations with corresponding details of pre-approved seismic restraints, with seismic loads and seismic force level (Fp) calculations; pre-engineered and stamped by a Massachusetts Licensed Professional Engineer experienced in seismic restraint systems.

B. Product Data: Catalog sheets, specifications and installation instructions for each item specified except fasteners.

C. Quality Control Submittals:

1. Seismic Restraint Manufacturer's Qualifications Data:

a. Name of firm producing the seismic restraints, business address and telephone number.
b. Period of time firm has been in the business producing seismic restraints, and names and addresses of 3 similar projects that the manufacturer has produced seismic restraints for during the past 5 years.

2. Company Field Advisor Data:

a. Name, business address and telephone number of Company Field Advisor secured for the required services.
b. Certified statement from the Company listing the qualifications of the Company Field Advisor.
c. Services and each product for which authorization is given by the Company, listed specifically for this project.

3. Manufacturer's Certificate of Compliance for Seismic Restraints: Certificate from seismic restraint manufacturer stating that the restraint and its mounting system or anchorage has been tested or analyzed and meets the requirements of Massachusetts Building Code, 780 CMR.

1.02 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with the applicable requirements of the ASME B31 Piping Codes.
2. Unless otherwise shown or specified, comply with the requirements of the Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS) Standards SP-58, and SP-69.
3. Materials for use in Sprinkler Systems and Standpipe and Hose Systems shall comply with the requirements of NFPA 13 and NFPA 14 as applicable.
4. The contractor shall provide pre-engineered or stamped and signed details (by a Massachusetts Licensed Professional Engineer) of seismic restraint systems to meet total design lateral force requirements for support and restraint of mechanical and electrical systems.
5. Seismic components shall be UL listed or California OSHPD (Office of Statewide Health Planning and Development) approved.

B. Seismic Restraint Manufacturer Qualifications: The firm producing the seismic restraints shall be experienced in seismic restraint work and shall have produced seismic restraints for a minimum of 5 years.

C. Company Field Advisor: Secure the services of a Company Field Advisor from seismic restraint manufacturer for the following:

1. Render advice regarding installation and final adjustment of seismic restraint system.
2. Render advice on the suitability of each seismic restraint for its particular application.
3. Inspect completed installation of seismic restraint system and certify with an affidavit that the system is installed in accordance with the Contract Documents and is operating properly.
4. Train facility maintenance personnel on the installation of seismic restraint system and routine maintenance of the system.

1.03 PRE-INSTALLATION CONFERENCE (FOR ALL MEP/FP TRADE CONTRACTORS)

A. Installation of MEP/FP systems within the superstructure of the parking garage shall not proceed until after the conclusion and distribution of the pre-installation meeting minutes.

B. At least 10 days prior to installation of the electrical, mechanical, plumbing & fire protection components within the precast superstructure, the contractor shall conduct a meeting with the Owner's representative, resident engineer and Contractor's representatives to review and to discuss the methods and procedures to achieve the quality installation as specified under "Installation". The contractor

shall send a pre-installation conference agenda to all attendees 5 days prior to the schedule date of the conference.

C. The contractor shall require responsible representatives or every party who is concerned with the concrete work to attend the conference, including but not limited to the following:

1. Contractor's superintendent
2. Contractor responsible for field quality control.
3. Electrical/Fire Protection/Plumbing subcontractor
4. Electrical/Fire Protection/Plumbing Foreman

D. Minutes of the meeting shall be recorded, typed and printed by the contractor and distributed to all parties concerned within 5 days of meeting. One copy of the minutes shall also be transmitted to the following for informational purposes:

1. Owner's representative
2. Resident engineer
3. Consultant Engineer

PART 2 - PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

A. Combination clevis hanger.

B. Pipe Hangers: Height adjustable standard duty clevis type, with cross bolt and nut.

1. Swivel ring type hangers will be allowed for sprinkler piping up to a maximum of 2 inches in size.

C. Adjustable Floor Rests and Base Flanges: Steel.

D. Hanger Rods: Mild, low carbon steel, fully threaded or threaded at each end, with two nuts at each end for positioning rod and hanger, and locking each in place.

E. Riser Clamps: Malleable iron or steel.

2.02 ANCHORS AND ATTACHMENTS

A. Sleeve Anchors (Group II, Type 3, Class 3): Molly's Div./USM Corp. Parasleeve Series, Ramset's Dynabolt Series, or Red Head/Phillips AN, HN, or FS Series.

B. Wedge Anchors (Zinc Plated, Group II, Type 4, Class 1): Hilti's Kwik Bolt Series, Molly's Div./USM Corp. Parabolt PB Series, Ramset's Trubolt T Series, or Red Head/Phillips WS Series.

C. Self-Drilling Anchors (Group III, Type 1): Ramset's RD Series, or Red Head/Phillips S Series.

D. Non-Drilling Anchors (Group VIII, Type 1): Ramset's Dynaset DS Series, Hilti's HDI Series, or Red Head/Phillips J Series.

E. Stud Anchors (Group VIII, Type 2): Red Head/Phillips JS Series.

F. Beam Clamps: Forged steel beam clamp, with weldless eye nut (right hand thread), steel tie rod, nuts, and washers, Grinnell's Fig No. 292 (size for load, beam flange width, and rod size required).

G. Metal Deck Ceiling Bolts: B-Line Systems' Fig. B3019.

H. Continuous Slotted Type Concrete Insert, Galvanized:

1. Load Rating 800 lbs/ft: Kindorf's D-986.
2. Load Rating 1500 lbs/ft: Kindorf's D-980.
3. Load Rating 3000 lbs/ft: Hohmann & Barnard's Inc. Type CS-H.
4. Load Rating 4500 lbs/ft: Hohmann & Barnard's Inc. Type CS-HD.

I. Threaded Type Concrete Insert: Galvanized ferrous castings, internally threaded to receive 3/4 inch diameter machine bolts.

J. Wedge Type Concrete Insert: Galvanized box-type ferrous castings, designed to accept 3/4 inch diameter bolts having special wedge shaped heads.

2.03 SEISMIC RESTRAINT SYSTEM FOR PIPING

A. General:

1. Coordinate all structural attachments with the Owner's Representative.
2. Design analysis shall include calculated dead loads, static seismic loads, and capacity of materials utilized for the connection of the equipment or system to the structure.
3. Analysis shall detail anchoring methods, bolt diameter, and embedment depth.
4. Design seismic restraint devices to accept without failure the forces calculated per the applicable building code and as specified.
5. Friction from gravity loads shall not be considered resistance to seismic forces.
6. Fire protection systems shall meet the requirements of NFPA-13 and NFPA-14 for the building seismic requirements.
7. Construct seismic supports constructed so that support engagement is maintained.
8. Stamp seismic supports with manufacturer's name and part number for identification.
9. Design seismic supports specifically for mitigation of seismic force loads.
10. Design the stiffness of seismic restraints for mechanical equipment so that the load path for the restraint performs its intended function.
11. Where possible, utilize components designed with tamper resistant break-off bolt heads or break-off nuts to assure visual verification of proper installation.

12. Attachment components shall be UL Listed catalog components with published loads designed specifically for seismic application.

B. Type: Pre-engineered seismic restraint system designed to support and restrain piping to meet applicable lateral force requirements.

C. Acceptable Manufacturers:

1. B-Line.
2. Mason Industries.
3. TOLCO Inc.

D. Strut/Channel Bracing: 12 gauge solid steel with no holes, 1-5/8 inches wide x 1-5/8 inches deep of single lengths or stitch-welded back-to-back configurations.

E. Pipe Bracing: Schedule 40 steel pipe.

F. Cable Bracing: Pre-stretched galvanized aircraft cable 7 x 19 strand core.

G. Rigid Seismic Braces For Single Hung Pipe Systems: A12 strut channel or schedule 40 steel pipe.

1. Maximum Brace Length: 13 feet 1 inches.

H. Rigid Seismic Braces For Trapeze Supported Pipe Systems: A12 strut channel or schedule 40 steel pipe.

1. Maximum Brace Length: 13 feet 1 inches.

I. Cable Seismic Braces For Single Hung Pipe Systems: Pre-stretched aircraft cable 7 x 19 core.

J. Cable Seismic Braces For Trapeze Supported Pipe Systems: Pre-stretched aircraft cable 7 x 19 core.

K. Structural Attachments for Rigid and Cable Seismic Braces For Single Hung and Trapeze Supported Pipe Systems:

1. Structural attachments shall be positive.
2. Do not make structural attachments to the bottom of a bar joist.
3. Supplemental steel shall be installed for all pre-cast decks less than 4 inches thick
4. Do not use concrete inserts or continuous concrete insert strut to attach brace.
5. Wedge type anchors are permitted. The size and embedment depth shall be determined by the supplier of the seismic restraint system and as approved.

L. Vertical Brace Component (up-thrust protection)

1. Reinforce Vertical Hanger Rod when lengths exceed the following:

a. 3/8 inch dia rod: 19 inches.
b. 1/2 inch dia rod: 25 inches.
c. 5/8 inch dia rod: 31 inches.
d. 7/8 inch dia rod: 43 inches.
e. 1 inch dia rod: 50 inches.
f. 1-1/4 inch dia rod: 62 inches.

2.04 FASTENERS

A. Bolts, Nuts, Washers, Lags, and Screws: Medium carbon steel; size and type to suit application; galvanized for high humidity locations, and treated wood; plain finish for other interior locations. Except where shown otherwise on the Drawings, furnish type, size, and grade required for proper installation of the Work.

2.05 SHOP PAINTING AND PLATING

A. Hangers, supports, rods, inserts and accessories used for pipe supports, unless chromium plated, cadmium plated or galvanized shall be shop coated with metal primer paint.

PART 3 - EXECUTION

3.01 PREPARATORY WORK

A. Place inserts into construction form work expeditiously, so as not to delay the Work.

3.02 INSTALLATION

A. Do not hang or support one pipe from another or from ductwork.

1. Do not bend threaded rod.

B. Support all insulated horizontal piping conveying fluids below ambient temperature, by means of hangers or supports with insulation shields installed outside of the insulation.

C. Space hangers or supports for horizontal piping on maximum center distances as listed in the following hanger schedules, except as otherwise specified, or noted on the Drawings.

1. For Steel Pipe:

PIPE SIZE (Inches)	MAXIMUM SPACING (Feet)
1 and under	8
1-1/4 and 1-1/2	9
2	10
2-1/2 and up	12

2. For Grooved End Steel Pipe: No pipe length shall be left unsupported between any two coupling joints.

PIPE SIZE (Inches)	MAXIMUM SPACING (Feet)
1-1/2 and under	7
2 through 4	10
5 and over	12

3. For Directional Changes: Install a hanger or support close to the point of change of direction of all pipe runs in either a horizontal or vertical plane.
4. For Concentrated Loads: Install additional hangers or supports, spaced as required and directed, at locations where concentrated loads such as in-line pumps, valves, fittings or accessories occur, to support the concentrated loads.
5. For Branch Piping Runs and Runouts Over 5 feet In Length: Install a minimum of one hanger, and additional hangers if required by the hanger spacing schedules.
6. Parallel Piping Runs: Where several pipe lines run parallel in the same plane and in close proximity to each other, trapeze hangers may be submitted for approval. Base hanger spacing for trapeze type hangers on the smallest size of pipe being supported. Design the entire hanger assembly based on a safety factor of five, for the ultimate strength of the material being used.

D. Minimum Hanger Rod Size: Increase hanger rod size as required to meet requirements of seismic restraint system.

PIPE OR TUBING SIZE (Inches)	SINGLE ROD HANGER SIZE (Inches)		DOUBLE ROD HANGER SIZE (Inches)	
	PIPE	TUBING	PIPE	TUBING
1/2 to 2	3/8	1/4	3/8	1/4
2-1/2 and 3	1/2	3/8	3/8	1/4
4 and 5	5/8	1/2	1/2	3/8
6	3/4	1/2	5/8	1/2

PIPE OR TUBING SIZE (Inches)	SINGLE ROD HANGER SIZE (Inches)		DOUBLE ROD HANGER SIZE (Inches)	
	PIPE	TUBING	PIPE	TUBING
8, 10 and 12	7/8	5/8	3/4	5/8

1. Secure hanger rods as follows: Install one nut under clevis, angle or steel member; one nut on top of clevis, angle or steel member; one nut inside insert or on top of upper hanger attachment and one nut and washer against insert or on lower side of upper hanger attachment. A total of four nuts are required for each rod, two at upper hanger attachment and two at hanger.

E. Vertical Piping:

1. Support vertical risers of piping systems, by means of heavy duty hangers installed close to base of pipe risers, and by riser clamps with extension arms at intermediate floors, with the distance between clamps not to exceed 25 feet, unless otherwise specified. Support pipe risers in vertical shafts equivalent to the aforementioned. Install riser clamps above floor slabs, with the extension arms resting on floor slabs. Provide adequate clearances for risers that are subject to appreciable expansion and contraction, caused by operating temperature ranges.
2. Support extension arms of riser clamps, secured to risers to be insulated for cold service, 4 inches above floor slabs, to allow room for insulating and vapor sealing around riser clamps.

F. Floor Supports: Install adjustable yoke rests with base flanges, for the support of piping, unless otherwise indicated on the Drawings. Install supports in a manner, which will not be detrimental to the building structure.

3.03 UPPER HANGER ATTACHMENTS

A. General:

1. Secure upper hanger attachments to overhead structural steel, steel bar joists, or other suitable structural members.
2. Do not attach hangers to steel decks that are not to receive concrete fill.
3. Do not attach hangers to precast concrete plank decks less than 2-3/4 inches thick.
4. Do not use flat bars or bent rods as upper hanger attachments.

B. Attachment to Steel Frame Construction: Provide intermediate structural steel members where required by pipe support spacing. Select steel members for use as intermediate supports based on a minimum safety factor of five.

1. Do not use drive-on beam clamps.
2. Do not support piping over 4 inches in size from steel bar joists. Secure upper hanger attachments to steel bar joists at panel points of joists.
3. Do not drill holes in main structural steel members.
4. Beam clamps, with tie rods as specified, may be used as upper hanger attachments for the support of piping, subject to clamp manufacturer's recommended limits.

C. Attachment to Concrete Filled Steel Decks:

1. New Construction: Install metal deck ceiling bolts.
2. Existing Construction: Install welding studs (except at roof decks). Do not support a load in excess of 250 lbs from any single welded stud.
3. Do not attach hangers to decks less than 2-1/2 inches thick.

D. Attachment to Cast-In-Place Concrete: Secure to overhead construction by means of cast-in-place concrete inserts.

E. Attachment to Cored Precast Concrete Decks (Flexicore, Dox Plank, Spancrete, etc.): Toggle bolts may be installed in cells for the support of piping up to a maximum of 2-1/2 inches in size.

F. Attachment to Hollow Block or Hollow Tile Filled Concrete Decks:

1. New Construction: Omit block or tile and pour solid concrete with cast-in-place inserts.
2. Existing Construction: Break out block or tile to access, and install machine bolt anchors at highest practical point on side of web.

G. Attachment to Waffle Type Concrete Decks:

1. New Construction: Install cast-in-place inserts.
2. Existing Construction: Install machine bolt expansion anchors at highest practical point on side of web.

H. Attachment to Precast Concrete Tee Construction:

1. New Construction: Tee hanger inserts between adjacent flanges, except at roof deck without concrete fill.
2. Existing Construction: Dual unit expansion shields in webs of tees. Install shields as high as possible in the webs.

a. Exercise extreme care in the field drilling of holes to avoid damage to reinforcing.
b. Do not use powder driven fasteners.

3.04 SEISMIC RESTRAINT SYSTEMS

A. General:

1. Install seismic restraints in accordance with seismic restraint manufacturer's printed installation instructions and guidelines unless otherwise specified.
2. Do not use powder-actuated fasteners for seismic restraint anchorage in tension applications.
3. Laterally support vertical risers with riser clamps at each floor unless otherwise specified.
4. When systems cross building seismic separation points, pass between buildings, or are supported from different portions of the building, install to allow differential support displacements without damaging the pipe, equipment or support connections. Install pipe loops, anchors, offsets, and guides as required to provide specified capability of motion and limit movement of adjacent piping.
5. Do not brace seismic bracing to different parts of the building that may respond differently during seismic activity.
6. Provide adequately sized openings in walls, floors, and ceilings for anticipated seismic movement. Provide fire stopping in fire-rated walls.
7. Seismic restraint installations shall not cause any modifications in the positioning of equipment or piping resulting in stresses or misalignment.
8. No rigid connections between equipment, piping, duct, or conduit shall be made to the building structure that degrades the noise and vibration-isolation system specified.
9. Bracing attached to structural members may present additional stresses. Submit loads to the Owner's Representative.
10. Provide vertical stiffening components to support rods when necessary to accept compressive loads. Welding of components to vertical support rods is not acceptable.
11. Clevis supported pipe must have cross-bolt support at each seismic bracing location.
12. Notify Owner's Representative if any discrepancies between the specifications and field conditions prior to installation.

B. Seismic Restraints for Piping:

1. Trapeze assemblies supporting pipes shall be braced considering the total weight of the pipes on the trapeze.
2. Provide transverse bracing at 40 ft. maximum spacing for welded steel pipe, brazed copper pipe or grooved piping with UL 213 listed connections.

a. Traverse bracing for threaded steel or copper pipe or non-listed UL grooved connections shall not exceed 20 ft. maximum.

3. Provide longitudinal bracing at 80 ft. maximum spacing for welded steel pipe, brazed copper pipe or grooved piping with UL 213 listed connections.

   a. Traverse bracing for threaded steel or copper pipe or non-listed UL grooved connections shall not exceed 40 ft. maximum.

4. Transverse piping restraints for one pipe section may also act as a longitudinal restraint for a pipe section of the same size connected perpendicular to it if the restraint is installed within 24-inches of the elbow centerline or tee or combined stresses are within allowable limits at longer distances.
5. Branch line piping shall not be used to brace main piping.

   a. No larger diameter pipe shall be braced by a smaller diameter pipe.

6. Attach all longitudinal seismic braces directly to piping.

   a. Encapsulate clamp and brace with insulation equal to that on the pipe.

7. Use hold down clamps to attach pipe to trapeze hangers before installing seismic restraints.
8. Brace vibration isolated piping with cables to allow flexibility.

END OF SECTION

SECTION 15316

SANITARY WASTE AND VENT PIPING
(Filed Sub-Bids Required)

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 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: P001, P100, P101, P102, P103, P104.

B. Sub-sub Bids are not required for this trade.

1.3 RELATED DOCUMENTS

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

1.4 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.

1.5 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class(es).

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

PART 3 - EXECUTION

3.1 PRE-INSTALLTION CONFERENCE

A. At least 10 days prior to installation of the electrical, mechanical, plumbing & fire protection components within the precast superstructure, the contractor shall conduct a meeting with the Owner’s representative, resident engineer and Contractor’s representatives to review and to discuss the methods and procedures to achieve the quality installation as specified under “Installation”. The contractor shall send a preinstallation conference agenda to all attendees 5 days prior to the schedule date of the conference.

B. The contractor shall require responsible representatives or every party who is concerned with the concrete work to attend the conference, including but not limited to the following: Contractor's superintendent
   a. Contractor responsible for field quality control.

b. Electrical/Fire Protection/Plumbing subcontractor.
c. Electrical/Fire Protection/Plumbing Foreman.

C. Minutes of the meeting shall be recorded, typed and printed by the contractor and distributed to all parties concerned within 5 days of the meeting. One copy of the minutes shall also be transmitted to the following for information purposes:
   a. Owner's representative
   b. Resident engineer
   c. Consultant engineer

3.2 PIPING INSTALLATION

A. No installation of any MEP/FP shall commence until coordination plans indicating proposed routings, locations, mountings and similar information submitted and reviewed. No installation shall be allowed until preinstallation meetings have been conducted.

B. Contractor shall install conduit, branch circuitry, home runs, risers and all other electrical components at locations and in a manner that they will not be subject to damage by vehicles including and not limited to vehicles bumpers.

C. Branch conduit to shall be ceiling mounted.

D. Contractor shall install conduit, branch circuitry, home runs, risers and all other electrical components in a neat workmanship manner at locations and routes that do not visually detract from the garage aesthetics with attention to walls, stairs, lobbies, ceilings areas at stair and stair/elevator towers and areas subject to pedestrian traffic.

E. Installations shall be located and installed in such a manner to minimize the potential for moisture related deterioration under precast floor joints with joint sealants.

F. No electrified fixtures, lamps etc… shall be installed at ceiling locations between precast tee stems with tee to tee joints. No horizontal conduit runs shall be installed parallel to precast tee to tee joints between tee stems with tee to tee joints.

G. No conduit shall be allowed to be mounted at or on an inverted “T” beam

H. All conduit shall be mounted tight against precast elements; no suspended conduit allowed.

I. Contractor shall utilize designated vertical chases as shown on the drawings or as approved by the Owner for ALL vertical risers.

J. ALL conduit routed to a wall or column mounted device/equipment shall be routed up to the ceiling to the ceiling mounted branch circuitry.

K. Any fixture, conduit, circuit that does not comply or is a zone subject to vehicular damage shall be relocated at no cost to the owner.

L. MEP/FP material installed prior to the review of coordination drawings and the distribution of accepted preinstallation coordination meeting minutes shall be subject to removal

and reinstallation at routes and locations designated by the Owner, Owner's Project Manager and/or the Engineer.

M. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

N. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

O. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

P. Install piping to permit valve servicing.

Q. Install piping at indicated slopes.

R. Install piping free of sags and bends.

S. Install fittings for changes in direction and branch connections.

T. Install piping to allow application of insulation.

U. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

V. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

W. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

X. Install engineered soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

Y. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.

C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

3.4 HANGER AND SUPPORT INSTALLATION

A. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

D. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

E. Install supports for vertical cast-iron soil piping every 15 feet.

F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.

3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main.
2. Sewage Pump: To sewage pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.6 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping NPS 4 and smaller shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

C. Aboveground, vent piping NPS 4 and smaller shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

D. Underground, soil, waste, and vent piping NPS 4 and smaller shall be the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.

E. Underground, soil and waste piping NPS 5 and larger shall be any of the following:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.

END OF SECTION 15316

SECTION 15319

SANITARY WASTE PIPING SPECIALTIES
(Filed Sub-Bids Required)

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 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: P001, P100, P101, P102, P103, P104.

B. Sub-sub Bids are not required for this trade.

1.3 RELATED DOCUMENTS

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

1.4 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Floor drains.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:

1. Cleanouts.
2. Floor drains.

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

PART 2 - PRODUCTS

2.1 CLEANOUTS

A. Exposed Metal Cleanouts:

1. Standard: Insert standard for cleanout test tee.
2. Size: Same as connected drainage piping
3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
4. Closure: Raised brass plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Metal Floor Cleanouts:

1. Standard: ASME A112.36.2M for cast-iron soil pipe with cast-iron ferrule cleanout.
2. Size: Same as connected branch.
3. Type: Cast-iron soil pipe with cast-iron ferrule.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Not required.
6. Outlet Connection: Inside calk.
7. Closure: Cast-iron plug.
8. Top Loading Classification: Heavy Duty.
9. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains P-001:

1. Standard: ASME A112.6.3.
2. Pattern: Floor drain.
3. Outlet: Bottom.
4. Coating on Interior and Exposed Exterior Surfaces: Not required.
5. Top or Strainer Material: Cast Iron.
6. Top of Body and Strainer Finish: Cast Iron.
7. Top Shape: Square.

PART 3 - EXECUTION

3.1 CONNECTIONS

A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.

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

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

   a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
   b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
   c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.

4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install piping adjacent to equipment to allow service and maintenance.

3.2 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 15319

SECTION 15320

STANDPIPE AND HOSE SYSTEM

PART 1 - GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Standpipe Piping: Section 15300.

B. Fire Protection Pipe Hangers and Supports: Section 15310.

1.02 SUBMITTALS

A. Product Data:

1. Catalog sheets, specifications and installation instructions for each item specified.
2. Schedule of pipe and fittings including manufacturer, materials, and pressure rating of fitting.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Except as otherwise shown, or specified, comply with the National Fire Protection Association Standard for the Installation of Standpipe and Hose Systems, NFPA-14,

   a. Standpipe System Type: Manual-Dry.
   b. Standpipe System Class: I.

2. Conform to Local Fire Department Regulations. Where conflicts occur in the above Code requirements, the most stringent requirements shall apply.

B. Listing and Approval:

1. All materials and equipment installed shall be Underwriters' listed, or Factory Mutual approved, as being suitable for use in standpipe and hose systems.

1.04 MAINTENANCE

A. Special Tools: Deliver 2 keys for each lock to the Owner's Representative.

1.05 PRE-INSTALLATION CONFERENCE (FOR ALL MEP/FP TRADE CONTRACTORS)

A. Installation of MEP/FP systems within the superstructure of the parking garage shall not proceed until after the conclusion and distribution of the pre-installation meeting minutes.

B. At least 10 days prior to installation of the electrical, mechanical, plumbing & fire protection components within the precast superstructure, the contractor shall conduct a meeting with the Owner's representative, resident engineer and Contractor's representatives to review and to discuss the methods and procedures to achieve the quality installation as specified under "Installation". The contractor shall send a pre-installation conference agenda to all attendees 5 days prior to the schedule date of the conference.

C. The contractor shall require responsible representatives or every party who is concerned with the concrete work to attend the conference, including but not limited to the following:

1. Contractor's superintendent
2. Contractor responsible for field quality control.
3. Electrical/Fire Protection/Plumbing subcontractor
4. Electrical/Fire Protection/Plumbing Foreman

D. Minutes of the meeting shall be recorded, typed and printed by the contractor and distributed to all parties concerned within 5 days of meeting. One copy of the minutes shall also be transmitted to the following for informational purposes:

1. Owner's representative
2. Resident engineer
3. Consultant Engineer

PART 2 - PRODUCTS

2.01 HOSE VALVES

A. Hose Valve for Class I Service: 2-1/2 inch double ips female compression angle valve, 300 psig WOG, rough brass body with a bonnet and spindle of polished brass, and spoked handwheel.

1. Reducer: Cast brass, rough finish, oval lug reducing fitting 2-1/2 inch female hose to 1-1/2 inch male hose threads with cap and chain.

B. Coordinate hose valve thread requirements with local fire department.

C. Spanner: Malleable iron with head size and configuration to fit all hose connections within the cabinet; provide brass chain and hook.

2.02 FIRE DEPARTMENT CONNECTIONS (Contractor shall coordinate final type and location with local fire department)

A. 5" Storz Connection: Projecting wall type at 30 angle down, brass with polished finish, plugs and chains, and escutcheon.

B. Identification: Cast the word "STANDPIPE" on escutcheon. Provide signage at the fire department connection indicating the system demand flow and pressure. Coordinate signage requirements with the local fire department.

2.03 GAGES

A. Accuracy: ASME B40.1 Grade B, plus or minus 2 percent of span; 0 to 300 psi standard range.

1. Case: Anodized aluminum, glass lens; copper alloy tube, tip and socket; brass movement.
2. Connection: 1/4 inch NPT male bottom connection.

2.04 LOCK FOR GATE VALVE

A. Padlock: Yale, Series No. 800. Furnish 2 keys with 1-1/2 inch diameter identification tags stamped with valve number and service and delete to the Owner's Representative..

B. Chain: Alloy steel, hot dipped galvanized; 3/16 inch welded link.

C. Coordinate lock requirements and specifications with the Owner's Representative.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install the Work of this Section in accordance with the manufacturer's printed installation instructions unless specified otherwise.

B. Ball Drip: Pipe to at suitable point of discharge over a floor drain, or as otherwise directed.

C. Air Chamber: Cap each standpipe at the ceiling of the highest hose connection, or 24 inches above the highest connection, whichever is higher.

D. Pressure Gage: Install at the top of each standpipe and placed so that gage may easily be read from the floor level.

E. Gate Valve: Lock in open position by means of chain looped through handwheel and around adjacent fire riser. Secure chain with padlock.

3.02 FIELD QUALITY CONTROL

A. System Tests:

1. Test all new Work. Test existing system only if directed.
2. Notify the Owner's Representative when the Work of this Section is ready for testing.
3. Perform tests in accordance with NFPA-14.

B. Identification: Affix decal to the exterior of the hose cabinet door after finish painting is applied.

END OF SECTION

SECTION 15323

SANITARY WASTE INTERCEPTORS
(Filed Sub-Bids Required)

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 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: P001, P100, P101, P102, P103, P104.

B. Sub-sub Bids are not required for this trade.

1.3 RELATED DOCUMENTS

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

1.4 SUMMARY

A. Section Includes:

1. Oil/water interceptors.

1.5 ACTION SUBMITTALS

A. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, based on input from Installers of the items involved:

1. Interceptors.

2. Piping connections. Include size, location, and elevation of each.
3. Interface with underground structures and utility services.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Sewer Services: Do not interrupt services to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sewer services according to requirements indicated:

1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of service.
2. Do not proceed with interruption of sewer services without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 OIL/WATER INTERCEPTORS

A. Oil/sand Interceptors: Precast concrete comply with ASTM C 913. Fiberglass portion shall comply with ASTM D-4097.

1. The separator shall be circular and constructed from pre-cast concrete with circular riser and slab components.

2. The concrete separator shall include a fiberglass insert bolted and sealed, watertight inside the concrete precast chamber, prior to delivery to the project site. The fiberglass insert must provide a lining for oil storage and retention as a secondary containment system within the OGS.

3. The separator shall be allowed to be considered as a bend or junction structure within the stormwater drainage system.

4. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow. The concrete joints shall be water-tight and meet the design criteria according to ASTM C-443.

5. Structural Design Loads:

   a. Light-Traffic Load: Comply with ASTM C 890, A-8 (ASSHTO HS10-44).
   b. Medium-Traffic Load: Comply with ASTM C 890, A-12 (ASSHTO HS15-44).
   c. Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
   d. Walkway Load: Comply with ASTM C 890, A-03.

6. Resilient Pipe Connectors: ASTM C 923, cast or fitted into interceptor walls, for each pipe connection.

7. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, to match diameter of manhole frame and cover.
8. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange and 26-inch-diameter cover.

    a. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
    b. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.

2.2 PRECAST-CONCRETE MANHOLE RISERS

A. Precast-Concrete Manhole Risers: ASTM C 913, with rubber-gasket joints.

1. Structural Design Loads:

    a. Light-Traffic Load: Comply with ASTM C 890, A-8 (ASSHTO HS10-44).
    b. Medium-Traffic Load: Comply with ASTM C 890, A-12 (ASSHTO HS15-44).
    c. Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
    d. Walkway Load: Comply with ASTM C 890, A-03.

2. Length: From top of underground concrete structure to grade.
3. Top Section: Eccentric cone, unless otherwise indicated. Include top of cone to match grade ring size.
4. Gaskets: ASTM C 443, rubber.

B. Grade Rings: Reinforced-concrete rings, 6- to 9-inch total thickness, diameter matching manhole frame and cover, and height as required to adjust the manhole frame and cover to indicated elevation and slope.

C. Manhole Frames and Covers: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange and 26-inch-diameter cover.

1. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
2. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install precast-concrete interceptors according to ASTM C 891. Set level and plumb.

B. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.

C. Set tops of manhole frames and covers flush with finished surface in pavements. Set tops 3 inches above finish surface elsewhere, unless otherwise indicated.

D. Set tops of grating frames and grates flush with finished surface.

3.2 CONNECTIONS

A. Piping installation requirements are specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Make piping connections between interceptors and piping systems.

3.3 IDENTIFICATION

A. Identification materials and installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.

1. Use warning tapes or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

END OF SECTION 15323

SECTION 15413

FACILITY STORM DRAINAGE PIPING
(Filed Sub-Bids Required)

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 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: P001, P100, P101, P102, P103, P104.

B. Sub-sub Bids are not required for this trade.

1.3 RELATED DOCUMENTS

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

1.4 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.

1.5 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water.

1.6 ACTION SUBMITTALS

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

1.7 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service classes.

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Standards: ASTM C 1277 and CISPI 310.
2. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

PART 3 - EXECUTION

3.1 PRE-INSTALLTION CONFERENCE

A. At least 10 days prior to installation of the electrical, mechanical, plumbing & fire protection components within the precast superstructure, the contractor shall conduct a meeting with the Owner’s representative, resident engineer and Contractor’s representatives to review and to discuss the methods and procedures to achieve the quality installation as specified under “Installation”. The contractor shall send a preinstallation conference agenda to all attendees 5 days prior to the schedule date of the conference.

B. The contractor shall require responsible representatives or every party who is concerned with the concrete work to attend the conference, including but not limited to the following: Contractor's superintendent

a. Contractor responsible for field quality control.
b. Electrical/Fire Protection/Plumbing subcontractor.
c. Electrical/Fire Protection/Plumbing Foreman.

C. Minutes of the meeting shall be recorded, typed and printed by the contractor and distributed to all parties concerned within 5 days of the meeting. One copy of the minutes shall also be transmitted to the following for information purposes:
   a. Owner's representative
   b. Resident engineer
   c. Consultant engineer

3.2 PIPING INSTALLATION

A. No installation of any MEP/FP shall commence until coordination plans indicating proposed routings, locations, mountings and similar information submitted and reviewed. No installation shall be allowed until preinstallation meetings have been conducted.

B. Contractor shall install conduit, branch circuitry, home runs, risers and all other electrical components at locations and in a manner that they will not be subject to damage by vehicles including and not limited to vehicles bumpers.

C. Branch conduit to shall be ceiling mounted.

D. Contractor shall install conduit, branch circuitry, home runs, risers and all other electrical components in a neat workmanship manner at locations and routes that do not visually detract from the garage aesthetics with attention to walls, stairs, lobbies, ceilings areas at stair and stair/elevator towers and areas subject to pedestrian traffic.

E. Installations shall be located and installed in such a manner to minimize the potential for moisture related deterioration under precast floor joints with joint sealants.

F. No electrified fixtures, lamps etc… shall be installed at ceiling locations between precast tee stems with tee to tee joints. No horizontal conduit runs shall be installed parallel to precast tee to tee joints between tee stems with tee to tee joints.

G. No conduit shall be allowed to be mounted at or on an inverted “T” beam

H. All conduit shall be mounted tight against precast elements; no suspended conduit allowed.

I. Contractor shall utilize designated vertical chases as shown on the drawings or as approved by the Owner for ALL vertical risers.

J. ALL conduit routed to a wall or column mounted device/equipment shall be routed up to the ceiling to the ceiling mounted branch circuitry.

K. Any fixture, conduit, circuit that does not comply or is a zone subject to vehicular damage shall be relocated at no cost to the owner.

L. MEP/FP material installed prior to the review of coordination drawings and the distribution of accepted preinstallation coordination meeting minutes shall be subject to removal and reinstallation at routes and locations designated by the Owner, Owner's Project Manager and/or the Engineer.

M. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

N. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

O. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

P. Install piping to permit valve servicing.

Q. Install piping at indicated slopes.

R. Install piping free of sags and bends.

S. Install fittings for changes in direction and branch connections.

T. Install piping to allow application of insulation.

U. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

V. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

W. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

X. Install engineered soil and waste drainage and vent piping systems as follows:

1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
2. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

Y. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 PIPING INSTALLATION

A. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

B. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

C. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

D. Install piping at indicated slopes.

E. Install piping free of sags and bends.

F. Install fittings for changes in direction and branch connections.

G. Install piping to allow application of insulation.

H. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

I. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

J. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

   1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

K. Plumbing Specialties:

   1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
   2. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."

L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

M. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

N. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

O. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.4 JOINT CONSTRUCTION

A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Hub-and-Spigot, Cast-Iron Soil Piping Calked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.

C. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
3. Vertical Piping: MSS Type 8 or Type 42, clamps.
4. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

5. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
6. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
6. Spacing for 10-foot pipe lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.

C. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.7 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping NPS 6 and smaller shall be the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.

C. Underground storm drainage piping NPS 6 and smaller shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

D. Underground, storm drainage piping NPS 8 and larger shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.

END OF SECTION 15413

SECTION 15529

HANGERS AND SUPPORTS FOR PLUMBING PIPING
(Filed Sub-Bids Required)

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 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: P001, P100, P101, P102, P103, P104.

B. Sub-sub Bids are not required for this trade.

1.3 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Fastener systems.
3. Pipe stands.
4. Pipe positioning systems.
5. Equipment supports.

1.4 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.5 PERFORMANCE REQUIREMENTS

A. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
3. Design seismic-restraint hangers and supports for piping and equipment.

1.6 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

2.2 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.3 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Fastener System Installation:
   1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

C. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

D. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

E. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

F. Install lateral bracing with pipe hangers and supports to prevent swaying.

G. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

J. Insulated Piping:

   1. Attach clamps and spacers to piping.

      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

   2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
   3. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
b. NPS 4: 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.

4. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.3 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports and attachments for general service applications.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
5. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

6. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
2. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

END OF SECTION 15529

SECTION 15719

PIPING INSULATION
(Filed Sub-Bids Required)

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 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: P001, P100, P101, P102, P103, P104.

B. Sub-sub Bids are not required for this trade.

1.3 RELATED DOCUMENTS

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

1.4 SUMMARY

A. Section includes insulating the following HVAC piping systems:

1. Condensate drain piping, indoors.
2. Refrigerant suction and hot-gas piping, indoors.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.8 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.9 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

G. All insulation subject to condensation shall have a permeance rating of 0.0000.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

C. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

   1. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   2. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

K. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

L. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

M. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

N. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches .
4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."
3. Refer to architectural drawings for locations of fire-rated assemblies.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the

connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.
4. Near-piping to radiators. (piping located within the conditioned space).

3.8 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F :

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 3/4 inch thick.

B. Refrigerant Suction and Hot-Gas tubing and piping:

1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick.

3.9 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Flexible tubing and piping:
1. All Pipe Sizes: Insulation shall be the following:

a. Flexible Elastomeric: 1 inch thick.

END OF SECTION 15719

SECTION 16050

BASIC ELECTRICAL MATERIALS AND METHODS
(Filed Sub-Bids Required)

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 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: E-001, E-002, E-111, E-121, E-131, E-141.

B. Sub-sub Bids are not required for this trade.

1.3 SUMMARY

A. This Section includes the following:
1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Common electrical installation requirements.

1.4 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene rubber.

1.5 SUBMITTALS

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

1.6 QUALITY ASSURANCE

A. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."

1.7 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:
   1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
   2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
   3. To allow right of way for piping and conduit installed at required slope.
   4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

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

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."

D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.138-inch thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

2.3 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
   1. Manufacturers:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Metraflex Co.
      d. Pipeline Seal and Insulator, Inc.
   2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
   3. Pressure Plates: Carbon steel. Include two for each sealing element.
   4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to raceways and piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

C. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

D. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

E. Rectangular Sleeve Minimum Metal Thickness:
   1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
   2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

F. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

G. Cut sleeves to length for mounting flush with both surfaces of walls.

H. Extend sleeves installed in floors 2 inches above finished floor level.

I. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require a different clearance.

J. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

K. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

L. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with Division 7 Section "Through-Penetration Firestop Systems."

M. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

N. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

O. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Through-Penetration Firestop Systems."

3.5 FIELD QUALITY CONTROL

A. Inspect installed sleeve and sleeve-seal installations and associated firestopping for damage and faulty work.

END OF SECTION 16050

SECTION 16060

GROUNDING AND BONDING
(Filed Sub-Bids Required)

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 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.
   1. The Work of this section is shown on Drawings: E-001, E-002, E-111, E-121, E-131, E-141.

B. Sub-sub Bids are not required for this trade.

1.3 SUMMARY

A. Section Includes: Grounding systems and equipment.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

   1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

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

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Bare Copper Conductors:

1. Stranded Conductors: ASTM B 8.

2.2 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductor Terminations and Connections:

1. Underground Connections: Welded connectors except as otherwise indicated.
2. Connections to Structural Steel: Welded connectors.

3.2 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

C. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70; use a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG.

1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
2. Bond grounding conductor to reinforcing steel in at least two locations and to anchor bolts.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Report measured ground resistances that exceed the following values:

1. Power System electric service equipment: 10 ohms.

E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 16060

SECTION 16073

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
(Filed Sub-Bids Required)

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 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: E-001, E-002, E-111, E-121, E-131, E-141.

B. Sub-sub Bids are not required for this trade.

1.3 SUMMARY

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

1.4 DEFINITIONS

A. EMT: Electrical metallic tubing.

1.5 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. ERICO International Corporation.
   d. GS Metals Corp.
   e. Thomas & Betts Corporation.
   f. Unistrut; Tyco International, Ltd.
   g. Wesanco, Inc.
2. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
3. Channel Dimensions: Selected for applicable load criteria.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
      a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
         1) Cooper B-Line, Inc.; a division of Cooper Industries.
         2) Empire Tool and Manufacturing Co., Inc.
         3) Hilti Inc.
         4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
         5) MKT Fastening, LLC.
   2. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
   3. Toggle Bolts: All-steel springhead type.
   4. Hanger Rods: Threaded steel.

2.2 SUPPORTING DEVICES IN DROP T-GRID CEILING

A. Support for devices in ceilings.
   1. Available manufacturer:
      a. Caddy
   2. For support of device boxes in ceilings for power or communication outlets. Provide Caddy 512HD hangers.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with single-bolt conduit clamps.

3.2 SUPPORT INSTALLATION

A. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

B. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   2. To Existing Concrete: Expansion anchor fasteners.
   3. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.

C. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

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

END OF SECTION 16073

SECTION 16074

VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS
(Filed Sub-Bids Required)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.
   1. The Work of this section is shown on Drawings: E-001, E-002, E-111, E-121, E-131, E-141.

B. Sub-sub Bids are not required for this trade.

1.3 General

1. This dual purpose section provides for vibration isolation and seismic control for the "equipment" as listed below.
2. It is the intent of the seismic restraint portion of this specification to provide restraint of non-structural building components. Restraint systems are intended to withstand the stipulated seismic accelerations applied through the component's center of gravity.
3. The work in this section includes the following:
   a. Vibration isolation elements for equipment.
   b. Seismic restraints for isolated equipment.
   c. Seismic restraints for non-isolated equipment.
   d. Certification of seismic restraint designs and installation supervision.

1.4 The term EQUIPMENT will be used throughout this specification and it includes ALL non-structural components within the facility and/or serving this facility, such as equipment located in outbuildings or outside of the main structure on grade within five

feet of the foundation wall. Equipment buried underground are excluded but entry of services through the foundation walls are included. Equipment referred to below is a partial list of equipment for reference. (Equipment not listed are still included in this specification) Battery Chargers, Battery Racks, Bus Ducts, Cable Trays, Conduit, Generators, Light Fixtures, Motor Control Centers, Panelboards, Switchboards, Switchgear, Transfer Switches, Transformers, Unit Substations, Variable Frequency Drives.

1.5 Life safety systems defined

a. All systems involved with fire protection systems.

b. All systems involved with and/or connected to emergency power supply including all generators, transfer switches, transformers, panelboards and all circuits to fire protection, smoke evacuation and/or emergency lighting systems.

c. All medical and life support systems.

d. Fresh air relief systems on emergency control sequence including conduit, dampers, etc.

1.6 Positive Attachment

a. Positive attachment is defined as a support location with a cast-in or wedge type expansion anchor, a double sided beam clamp, a welded or through bolted connection to the structure.

1.7 Transverse Bracing

a. Restraint(s) applied to limit motion perpendicular or angular to the centerline of the conduit, cable tray or busduct.

1.8 Longitudinal Bracing

a. Restraint(s) applied to limit motion along the centerline of the conduit, cable tray or busduct.

1.9 OEM Equipment Isolation Packages

A. Internal and/or External Systems

1. Substitution of internally or externally isolated and restrained equipment in lieu of the isolation and restraints specified in this section is acceptable provided all conditions of this section are met. The equipment manufacturer shall provide a letter of guarantee from their Engineering Department stamped and certified per the section on Seismic Restraints and Analysis stating that the seismic restraints are in full compliance with these specifications. Letters from field offices or representatives are unacceptable.

2. All costs for converting to the specified vibration isolation and/or restraints shall be borne by the equipment manufacturer in the event of non-compliance with the preceding.
3. In the event that the equipment is internally isolated and restrained, the entire unit assembly must be seismically attached to the structure. This attachment and certification thereof shall be by this section.

B. Submittal Data Requirements
1. Submittals
2. Catalog cuts or data sheets on specific vibration isolators and restraints to be utilized detailing compliance with the specification. Reference "TYPE" as per "MATERIALS" Section of this specification.
3. An itemized list of all isolated and non-isolated equipment. Detailed schedules showing isolator and seismic restraints proposed for each piece of equipment, referencing material and seismic calculation drawing numbers.

C. Shop Drawings
1. When walls and slabs are used as seismic restraint locations, details of acceptable methods for ducts, conduit and pipe must be included.
2. Indicate isolation devices selected with complete dimensional and deflection data before condition is accepted for installation.
3. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.
4. Coordinated or contract drawings shall be marked-up with the specific locations and types of restraints shown for all conduits, bus duct and cable tray. Rod bracing and assigned load at each restraint location shall be clearly delineated. Any and all tributary loads shall be considered for proper restraint sizing.
5. For ceiling suspended equipment provide minimum/maximum installation angle allowed for restraint system as well as braced and unbraced rod lengths at each allowable installation condition.

D. Seismic Certification and Analysis
1. Seismic restraint calculations must be provided for all connections of equipment to the structure. All performance of products (such as; strut, cable, anchors, clips, etc.) associated with restraints must be supported with manufacturer's data sheets or certified calculations.
2. Seismic restraint calculations must be based on the acceleration criteria shown in Table A acting through the equipment’s center of gravity.
3. Certification of calculations to support seismic restraint designs must be stamped by a registered professional engineer in New Hampshire.

4. Analysis must indicate calculated dead loads, derived loads and materials utilized for connections to equipment and structure. Analysis must detail anchoring methods, bolt diameter, embedding and/or weld length.
5. Manufacturer's Responsibility

a. Manufacturer of vibration and seismic control equipment shall have the following responsibilities:

(1) Determine vibration isolation and seismic restraint sizes and locations.
(2) Provide equipment vibration isolation and seismic restraints as specified.
(3) Guarantee specified isolation system deflections.
(4) Provide installation instructions, drawings and field supervision to insure proper installation and performance of systems.
(5) Certify correctness of installation upon completion.

E. Related Work

1. Housekeeping Pads

a. Housekeeping pad attachment shall be by the Project Structural Engineer. Material and labor required for attachment and construction shall be by the Concrete Section Contractor.

b. Housekeeping pads shall be coordinated with the Seismic Restraint vendor and sized to provide a minimum edge distance of 10 bolt diameters of clearance all around the outermost anchor bolt to allow for the use of full anchor ratings.

2. Supplementary Support Steel

a. Contractor shall supply supplementary support steel and connections for all equipment and piping, as required.

3. Attachments

a. Contractor shall provide restraint attachment plates cast into housekeeping pads, concrete inserts, double sided beam clamps, etc. in accordance with the requirements of the Seismic Restraint vendor.

TABLE A

"G" FORCES FOR VARIOUS CONDITIONS (SEISMIC ZONE 2 - AV > 0.1 < 0.2)			
CONDUIT, CABLE TRAY and BUS DUCT	RIGIDLY MOUNTED EQUIPMENT	FLEXIBLY MOUNTED EQUIPMENT	ALL LIFE SAFETY
.25	.40	.40	.60

F. Materials

1. Devices

a. All vibration isolation and seismic devices described in this section shall be the product of a single manufacturer. Mason Industries is the base manufacturer of these specifications; products of other manufacturers are acceptable provided their systems strictly comply with intent, structural design, performance and deflections of the Base Manufacturer.

2. Seismic Restraints and Vibration Isolation Types

a. All isolation and seismic restraint devices shall be capable of accepting, without failure, the "G" forces as determined by the seismic certification and calculations as described in the "SUBMITTAL DATA REQUIREMENTS" section of these specifications.

b. Corrosion protection for outdoor applications shall be as follows:

(1) Springs cadmium plated, zinc electroplated or powder coat.

(2) Hardware cadmium plated.

(3) All other metal parts hot spray or hot dipped galvanized.

c. All seismic restraint devices

(1) Shall maintain the equipment in a captive position and not short circuit isolation devices during normal operating conditions.

(2) Shall have provisions for bolting and/or welding to the structure.

d. Welding of springs to isolator housing, base plates, etc. is strictly prohibited.

3. Seismic Restraint Types

a. TYPE I: Same as Type B. Cast or aluminum housings, (except ductile iron) are not acceptable: Mason Ind. TYPE SLR.

b. TYPE II: Where required, each corner or side of equipment base shall incorporate a seismic restraint snubber having an all directional resilient pad limit stop. Restraints shall be fabricated of plate, structural members or square metal tubing. Angle bumpers are not acceptable: Mason Ind. Type Z-1225/Z-1011.

c. TYPE III: Restraints for suspended systems.

(1) Vibration isolated systems braced with multiple 7 x 19 strand galvanized cable rope. Mason Industries Type SCB.

(2) Non-isolated systems braced with structural steel strut type with approved fastening devices to equipment and structure: Mason Ind. Type SSB.

(3) Steel angles (by contractor) shall be provided to prevent rod bending of hung equipment where indicated by the Seismic Restraint vendor’s submittals. Steel angles shall be attached to the rods with a minimum of three ductile iron

clamps at each restraint location. Welding of support rods to angles is not acceptable. Rod clamp assemblies shall have Anchorage Pre-approval “R” number from California OSHPD: Mason Ind. Model “SRC”.

(4) Pipe clevis cross braces are required at all restraint locations. They shall be special purpose preformed channels deep enough to be held in place by bolts passing over the clevis cross bolt. Clevis cross braces shall have Anchorage Pre-approval “R” number from California OSHPD: Mason Ind. Model “CCB”.

d. TYPE IV: Double deflection neoprene isolator encased in ductile iron or steel casing.

(1) Mountings shall have Anchorage Pre-approval “R” number from California OSHPD, certifying the horizontal and vertical seismic load ratings: Mason Industries Type RC or BR.

e. TYPE V: Rigid attachment to structure utilizing wedge type expansion anchors for bolting and steel plates, either cast-in or anchored with wedge type expansion bolts, for welding. Powder shots are not acceptable. Concrete anchor bolt spacing shall be in accordance with manufacturer’s published standards.

4. Vibration Isolator Types

a. TYPE A: Spring Isolator - Free Standing

(1) Spring shall have a minimum outer diameter to overall height ratio of 0.8: 1 at rated deflection.

(2) Reserve deflection (from published load ratings to solid height) of 50% of the rated deflection.

(3) Ductile top cup with adjusting bolt tapped for equipment attachment locking cap screw.

(4) Minimum 1/4" thick neoprene acoustical base pad or cup on underside, unless designated otherwise: Mason Industries Type SLF.

b. TYPE B: Spring Isolator - Restrained

(1) Shall be the same as TYPE A with the following additional features.

(a) Integral restraining bolts with elastomeric cushions preventing metal-to-metal contact.

(b) Internal spring adjusting nut or bolt with leveling capability.

(c) Built-in all-directional limit stops with minimum 1/4" clearance under normal operation.

(d) Mountings shall have Anchorage Pre-approval “R” number from California OSHPD, certifying the horizontal and vertical seismic load ratings.

Mason Industries Type SLR, SSLFH.

c. TYPE C: NOT USED

d. TYPE D: Double deflection neoprene isolator encased in ductile iron or steel casing.

(1) Mountings shall have Anchorage Pre-approval "R" number from California OSHPD, certifying the horizontal and vertical seismic load ratings: Mason Industries Type RC or BR.

e. TYPE E: Elastomer Hanger Isolator

(1) Molded neoprene element with an integral bushing to insulate lower support rod from the hanger box.

(a) Steel hanger box shall withstand three times the rated load without failure: Mason Industries Type HD.

G. Installation

1. General

a. Isolation and seismic restraint systems must be installed in strict accordance with the manufacturer's written instructions and all submittal data.

b. Vibration isolators shall not cause any change of position of equipment resulting in stress on equipment connections.

2. Equipment Installation

a. Equipment shall be isolated as indicated in TABLE B at the end of this section.

b. Additional Requirements:

(1) Spring isolators shall be installed after all equipment is installed without changing equipment elevations.

(2) After the entire installation is complete and under full operational load, the spring isolators shall be adjusted so that the load is transferred from the blocks to the isolators.

(3) Remove all debris from beneath the equipment and verify that there are no short circuits of the isolation. The equipment shall be free in all directions.

(4) Install equipment with flexibility in wiring.

(5) Housekeeping pads for equipment in this Section must be properly doweled or bolted, using wedge type expansion bolted to the structure to meet the acceleration criteria. Anchor equipment or isolators to housekeeping pads, See D. RELATED WORK.

3. Seismic Restraints

a. Installation

(1) All floor mounted equipment whether isolated or not shall be snubbed, anchored, bolted or welded to the structure to comply with the required acceleration. Calculations that determine that isolated equipment movement may be less than the operating clearance of snubbers (restraints) do not preclude the need for snubbers. All equipment must be positively restrained to the structure.

(2) All suspended equipment shall be two or four point independently braced with TYPE III restraints, installed taught for non-isolated equipment and slack with ½" cable deflection for isolated equipment. Rod bracing shall be installed as per approved submittals and shop drawings. Equipment less than 50 lbs. is excluded.

(3) All horizontally suspended cable trays, bus duct and conduit shall use RESTRAINT TYPE III. Spacing of seismic bracing shall be as per TABLE C at the end of this Section.

(4) For all trapeze supported piping and conduit, the individual pipes and conduits must be transversely and vertically restrained to the trapeze support at the designated restraint locations.

(5) For overhead supported equipment, over stress of the building structure must not occur. Bracing may occur from:

(a) Flanges of structural beams.

(b) Upper truss chords in bar joists.

(c) Cast in place inserts or drilled and shielded inserts in concrete structures.

(6) Conduit Risers

(a) Where conduits pass through cored holes, core diameters to be a maximum of 2 inches larger than pipe O.D. Cored holes must be packed with resilient material or fire stop as specified in other Sections of this Specification and/or State and Local Codes. No additional horizontal seismic bracing is required at these locations.

(b) Conduit risers through cored holes require a riser clamp at each level on top of the slab attached in a seismically approved manner for vertical restraint.

(c) Conduit risers in pipe shafts require structural steel attached in a seismically approved manner at each floor level and a riser clamp at each floor level on top of, and fastened to the structural steel. The riser clamp and structural steel must be capable of withstanding all static and seismic loads.

(7) Ceiling mounted panel light fixtures shall be attached to lay-in ceilings with earthquake clips or other approved means of positive attachment to T-bar structure.
(8) All non-isolated floor or wall-mounted equipment shall use RESTRAINT TYPE III or V.
(9) Where base anchoring of equipment is insufficient to resist seismic forces, restraint TYPE III shall be located above the units' center of gravity to suitably resist "G" forces specified.
(10) A rigid piping system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: Wall and roof; solid concrete wall and a metal deck with lightweight concrete fill, bus duct, conduit, etc. crossing a building expansion joint.

b. Exclusions for Seismic Restraints On Non-Life Safety Systems:
(1) All conduit less than 2-1/2 inch diameter.
(2) All clevis or trapeze supported conduit, cable tray or bus duct suspended by hangers with positive attachment to the structure that are less than 12 inches in length as measured from the top of the conduit, cable tray or bus duct to the point of attachment to the structure. If the 12 inch limit is exceeded by any hanger in the run, seismic bracing is required for the run.

c. Exclusions for Seismic Restraints On Life Safety Equipment.
(1) Critical, Standby or Emergency power conduit less than 1 inch nominal diameter.

4. Inspection

a. Upon completion of installation of all vibration isolation and seismic restraint devices, the owner may elect to contract and outside consultant at the owner's expense to review the installation. Any deficiencies in the installation will be corrected immediately at the contractor's expense.

TABLE B Vibration Isolation & Seismic Restraint Requirements for Electrical Equipment			EQUIPMENT INSTALLATION ATTACHMENT POINT					
			ON GRADE			ABOVE GRADE		
EQUIPMENT	SIZE		ISOL	DEFL	BASE	ISOL	DEFL	BASE

		MOUNTIN G						
General Purpose Transformers - Dry Type	All	Floor	- -	- -	- -	D	0.30	- -
		Ceiling	- -	- -	- -	E	0.30	- -
Generators	All	Floor	B	0.75	- -	B	1.50	- -

TABLE B NOTES:
GENERAL : ISOL = Isolator, DEFL. = Deflection, All deflections indicated are in inches.

TABLE C SEISMIC BRACING TABLE			
EQUIPMENT	ON CENTER SPACING (Max)		WITHIN EACH CHANGE OF DIRECTION
	TRANSVERSE	LONGITUDIN AL	
CONDUIT	40 Feet	80 Feet	10 Feet
BUS DUCT	30 Feet	60 Feet	4 Feet

CABLE TRAY	40 Feet	80 Feet	10 Feet

END OF SECTION

SECTION 16075

ELECTRICAL IDENTIFICATION
(Filed Sub-Bids Required)

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 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: E-001, E-002, E-111, E-121, E-131, E-141.

B. Sub-sub Bids are not required for this trade.

1.3 SUMMARY

A. Section Includes:
1. Identification for conductors.
2. Underground-line warning tape.
3. Equipment identification labels.
4. Miscellaneous identification products.

1.4 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.5 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

1.6 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

2.2 UNDERGROUND-LINE WARNING TAPE

A. Tape:
1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:
1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

2.3 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.4 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.

G. Painted Identification: Comply with requirements in Division 9 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
   a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
   b. Colors for 208/120-V Circuits:
      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
   c. Colors for 480/277-V Circuits:
      1) Phase A: Brown.
      2) Phase B: Orange.
      3) Phase C: Yellow.
   d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to

prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

B. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

C. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
   1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
   2. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

D. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
   1. Install underground-line warning tape for both direct-buried cables and cables in raceway.

E. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
   1. Labeling Instructions:
      a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
      b. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
   2. Equipment to Be Labeled:
      a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
      b. Enclosures and electrical cabinets.
      c. Identify circuits contained in; pull-boxes, junction boxes and connection boxes, by labeling the inside of the cover using a indelible marker.
      d. Access doors and panels for concealed electrical items.
      e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
      f. Emergency system boxes and enclosures.
      g. Enclosed switches.
      h. Enclosed circuit breakers.
      i. Enclosed controllers.

j. Variable-speed controllers.
k. Push-button stations.
l. Contactors.
m. Remote-controlled switches, dimmer modules, and control devices.
n. Power-generating units.
o. Monitoring and control equipment.

END OF SECTION

SECTION 16120

CONDUCTORS AND CABLES
(Filed Sub-Bids Required)

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 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: E-001, E-002, E-111, E-121, E-131, E-141.

B. Sub-sub Bids are not required for this trade.

1.3 SUMMARY

A. This Section includes the following:
1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Alcan Products Corporation; Alcan Cable Division.
   2. American Insulated Wire Corp.; a Leviton Company.
   3. General Cable Corporation.
   4. Senator Wire & Cable Company.
   5. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN.

D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC with ground wire.

2.2 CONNECTORS AND SPLICES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. AFC Cable Systems, Inc.
   2. Hubbell Power Systems, Inc.
   3. O-Z/Gedney; EGS Electrical Group LLC.
   4. 3M; Electrical Products Division.
   5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

C. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal-clad cable, Type MC.

E. Branch Circuits Installed below Raised Flooring: Type THHN-THWN, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 16 Section "Electrical Supports and Seismic Restraints."

F. Identify and color-code conductors and cables according to Division 16 Section "Electrical Identification."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

END OF SECTION 16120

SECTION 16130

RACEWAYS AND BOXES
(Filed Sub-Bids Required)

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 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: E-001, E-002, E-111, E-121, E-131, E-141.

B. Sub-sub Bids are not required for this trade.

1.3 SUMMARY

A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.4 DEFINITIONS

A. RNC: Rigid nonmetallic conduit.

B. EMT:Electrical Metallic Tubing

1.5 SUBMITTALS

A. Product Data: For hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.

1. Custom enclosures and cabinets.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

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

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

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.

C. Rigid Steel Conduit: ANSI C80.1.

D. Joint Compound for Rigid Steel Conduit: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT

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

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

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corp.; Pipe & Plastics Group.

6. Condux International, Inc.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.

C. RNC: NEMA TC 2, Type EPC-80-PVC, unless otherwise indicated.

D. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

2.3 BOXES, ENCLOSURES, AND CABINETS

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

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

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.

C. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

D. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

E. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: RNC, Type EPC-80-PVC.
2. Underground Conduit: RNC, Type EPC-80-PVC, direct buried.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Enclosures: NEMA 250, Type 1.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. Provide rigid steel conduit 90's for all PVC conduit runs.

3.2 INSTALLATION

A. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

B. Complete raceway installation before starting conductor installation.

C. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

D. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

E. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

F. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.

2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.

G. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

H. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

I. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

J. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet.

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:

   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.

2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change.
3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

K. No installation of any MEP/FP shall commence until coordination plans indicating proposed routings, locations, mountings and similar information submitted and reviewed. No installation shall be allowed until preinstallation meetings have been conducted.

1. Contractor shall install conduit, branch circuitry, home runs, risers and all other electrical components at locations and in a manner that they will not be subject to damage by vehicles including and not limited to vehicles bumpers.
2. Branch conduit to shall be ceiling mounted,
3. Contractor shall install conduit, branch circuitry, home runs, risers and all other electrical components in a neat workmanship manner at locations and routes that do not visually detract from the garage aesthetics with attention to walls, stairs, lobbies, ceilings areas at stair and stair/elevator towers and areas subject to pedestrian traffic.
4. Installations shall be located and installed in such a manner to minimize the potential for moisture related deterioration under precast floor joints with joint sealants.

5. No electrified fixtures, lamps etc… shall be installed at ceiling locations between precast tee stems with tee to tee joints. No horizontal conduit runs shall be installed parallel to precast tee to tee joints between tee stems with tee to tee joints.
6. No conduit shall be allowed to be mounted at or on an inverted "T" beam
7. All conduit shall be mounted tight against precast elements; no suspended conduit allowed.
8. Contractor shall utilize designated vertical chases as shown on the drawings or as approved by the Owner for ALL vertical risers.
9. ALL conduit routed to a wall or column mounted device/equipment shall be routed up to the ceiling to the ceiling mounted branch circuitry.
10. Any fixture, conduit, circuit that does not comply or is a zone subject to vehicular damage shall be relocated at no cost to the owner.
11. MEP/FP material installed prior to the review of coordination drawings and the distribution of accepted preinstallation coordination meeting minutes shall be subject to removal and reinstallation at routes and locations designated by the Owner, Owner's Project Manager and/or the Engineer.

Pre-Installation Conference: (for all MEP/FP trade contractors)

1. At least 10 days prior to installation of the electrical, mechanical, plumbing & fire protection components within the precast superstructure, the contractor shall conduct a meeting with the Owner's representative, resident engineer and Contractor's representatives to review and to discuss the methods and procedures to achieve the quality installation as specified under "Installation". The contractor shall send a preinstallation conference agenda to all attendees 5 days prior to the schedule date of the conference.
2. The contractor shall require responsible representatives or every party who is concerned with the concrete work to attend the conference, including but not limited to the following:
    a. Contractor's superintendent
    b. Contractor responsible for field quality control.
    c. Electrical/Fire Protection/Plumbing subcontractor
    d. Electrical/Fire Protection/Plumbing Foreman
3. Minutes of the meeting shall be recorded, typed and printed by the contractor and distributed to all parties concerned within 5 days of the meeting. One copy of the minutes shall also be transmitted to the following for information purposes:
    a. Owner's representative
    b. Resident engineer
    c. Consultant engineer

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit.

2. Provide sand to surround conduits 6” in all directions.
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction.
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose.

5. Warning Tape: Bury warning tape approximately 18 inches above direct-buried conduits.

3.4 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 16130

SECTION 16140

WIRING DEVICES
(Filed Sub-Bids Required)

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 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: E-001, E-002, E-111, E-121, E-131, E-141.

B. Sub-sub Bids are not required for this trade.

1.1 SUMMARY

A. This Section includes the following:
1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Snap switches and wall-box dimmers.
4. Floor service outlets and multioutlet assemblies.

1.2 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

1.3 SUBMITTALS

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

B. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available,

obtain all wiring devices and associated wall plates from a single manufacturer and one source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

1.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

1.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
a. Cooper; 5351 (single), 5352 (duplex).
b. Hubbell; HBL5351 (single), CR5352 (duplex).
c. Leviton; 5891 (single), 5352 (duplex).
d. Pass & Seymour; 5381 (single), 5352 (duplex).

1.3 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-30R, and UL 498.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
a. Cooper.
b. Hubbell.
c. Leviton
d. Pass & Seymour.

1.4 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:
   1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
      a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
      b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
      c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
      d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

1.5 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
   1. 1000 W; dimmers shall require no derating when ganged with other devices.

1.6 WALL PLATES

A. Single and combination types to match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Finished Spaces: .035-inch-thick, satin-finished stainless steel.

1.7 MULTIOUTLET ASSEMBLIES

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. Hubbell Incorporated; Wiring Device-Kellems.
   2. Wiremold Company (The).

B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

C. System: Provide surface raceway systems for branch circuit, data network and voice wiring. Surface raceway system shall consist of raceway bases, covers,

pre-divided raceway bases, dual covers, appropriate fittings and device mounting plates necessary for a complete installation.

D. Configuration:
1. Raceways for classified wiring shall be two-piece design with base and snap-on cover. Raceway shall be available in widths of 2-3/4-inch and depths of 1-15/32-inch.
2. Raceways for power and unclassified wiring shall be multi-piece design with metal base and snap-on metal covers. Assembled base and cover is 4-3/4 inches wide by 1-3/4 inch. Base shall have 2 wiring channels, separated by 1 integral divider, large enough to accept standard power and communication devices without restricting capacity of the adjacent channel. Provide the base with tunnel knockouts in the divider wall that will facilitate the crossing over of services.

E. AF Series Raised Floor Boxes as manufactured by Wiremold / Legrand.
1. AF1 Series contains three separate compartments that accommodate a combination of both power and communication devices. The box lid shall be constructed of polycarbonate material, available in standard colors of black, brown and gray. The lid shall provide a removable cable guard for egress of power and communication workstation cables. The cable guards shall hold workstation cables in place with the lid either in the open or closed position.
2. The wiring chamber shall provide a minimum of three separate compartments to accommodate a combination of both power and communication wiring. The compartments shall be separated by use of die cast aluminum built in dividers.
3. The box shall be secured to the raised floor by the use of two locking tabs. The locking tabs shall be integral to the box and adjusted by use of their locking screws.

F. Raceway Material: Metal, with manufacturer's standard finish.

1.8 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.
1. Wiring Devices Connected to Normal Power System: White or Ivory, unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Delta Power System: Orange.

PART 2 - EXECUTION

2.1 INSTALLATION

A. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

B. Conductors:
1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
   a. Cut back and pigtail, or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted provided the outlet box is large enough.

C. Device Installation:
1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

D. Receptacle Orientation:
   1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

E. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

F. Dimmers:
   1. Install dimmers within terms of their listing.
   2. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

2.2 IDENTIFICATION

A. Comply with Division 16 Section "Electrical Identification."
   1. Receptacles: Identify panelboard and circuit number from which served. Use machine printing with black lettering on face of plate, and durable wire markers or tags inside outlet boxes.

END OF SECTION 16140

SECTION 16410

ENCLOSED SWITCHES AND CIRCUIT BREAKERS
(Filed Sub-Bids Required)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: E-001, E-002, E-111, E-121, E-131, E-141.

B. Sub-sub Bids are not required for this trade.

1.3 SUMMARY

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
1. Fusible switches.
2. Nonfusible switches.
3. Bolted-pressure contact switches.
4. High-pressure, butt-type contact switches.
5. Molded-case circuit breakers.
6. Molded-case switches.
7. Enclosures.

1.4 DEFINITIONS

A. GD: General duty.

B. GFCI: Ground-fault circuit interrupter.

C. HD: Heavy duty.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

1.5 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
   1. Enclosure types and details for types other than NEMA 250, Type 1.
   2. Current and voltage ratings.
   3. Short-circuit current rating.
   4. UL listing for series rating of installed devices.
   5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Manufacturer Seismic Qualification Certification: Submit certification that enclosed switches and circuit breakers, accessories, and components will withstand seismic forces defined in Division 16 Section "Electrical Supports and Seismic Restraints." Include the following:
   1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
      b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Qualification Data: For testing agency.

E. Field quality-control test reports including the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

F. Manufacturer's field service report.

G. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Closeout Procedures," include the following:
   1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
   2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
   2. Altitude: Not exceeding 6600 feet.

1.8 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Spares: For the following:
      a. Potential Transformer Fuses: 6
      b. Control-Power Fuses: 6
      c. Fuses and Fusible Devices for Fused Circuit Breakers: 6
      d. Fuses for Fusible Switches: 6
      e. Fuses for Fused Power Circuit Devices: 6
   2. Spare Indicating Lights: Six of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FUSIBLE AND NONFUSIBLE SWITCHES

A. Available Manufacturers:
   1. Eaton Corporation; Cutler-Hammer Products.
   2. General Electric Co.; Electrical Distribution & Control Division.
   3. Siemens Energy & Automation, Inc.
   4. Square D/Group Schneider.

B. Fusible Switch, 1200A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Nonfusible Switch, 1200A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.

3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.3 FUSED POWER CIRCUIT DEVICES

A. Bolted-Pressure Contact Switch: UL 977; operating mechanism shall use a rotary-mechanical-bolting action to produce and maintain high-clamping pressure on the switch blade after it engages the stationary contacts.
   1. Available Manufacturers:
      a. Boltswitch, Inc.
      b. Eaton Corporation; Cutler-Hammer Products.
      c. Pringle Electrical Mfg. Co.
      d. Siemens Energy & Automation, Inc.
      e. Square D/Group Schneider.

B. High-Pressure, Butt-Type Contact Switch: UL 977; operating mechanism shall use butt-type contacts and a spring-charged mechanism to produce and maintain high-contact pressure when switch is closed.
   1. Available Manufacturers:
      a. General Electric Co.; Electrical Distribution & Control Division.
   2. Main Contact Interrupting Capability: Twelve times the switch current rating, minimum.
   3. Operating Mechanism: Manual handle operation to close switch stores energy in mechanism for closing and opening.
      a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.
      b. Mechanical Trip: Operation of mechanical lever or push button or another device causes switch to open.
   4. Auxiliary Switches: Factory installed, SPDT, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
   5. Service-Rated Switches: Labeled for use as service equipment.
   6. Ground-Fault Relay: Comply with UL 1053. Self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.
      a. Configuration: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground fault indicator.
      b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
      c. No-Trip Relay Test: Operation of "no-trip" test control permits ground-fault simulation test without tripping switch.
      d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).
   7. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.

2.4 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Available Manufacturers:
   1. Eaton Corporation; Cutler-Hammer Products.
   2. General Electric Co.; Electrical Distribution & Control Division.
   3. Moeller Electric Corporation.
   4. Siemens Energy & Automation, Inc.
   5. Square D/Group Schneider.

B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. Electronic Trip-Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and I^2t response.
   4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.
   5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
   6. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.

C. Molded-Case Circuit-Breaker Features and Accessories:
   1. Standard frame sizes, trip ratings, and number of poles.
   2. Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and conductor material.
   3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
   4. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   5. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 16 Section "Electrical Power Monitoring and Control."
   6. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
   7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.

8. Auxiliary Switch: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
10. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

D. Molded-Case Switches: Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

E. Molded-Case Switch Accessories:
1. Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and material of conductors.
2. Application Listing: Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage. Provide "dummy" trip unit where required for proper operation.
4. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay. Provide "dummy" trip unit where required for proper operation.
5. Auxiliary Switch: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
6. Key Interlock Kit: Externally mounted to prohibit operation; key shall be removable only when switch is in off position.

2.5 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
1. Outdoor Locations: NEMA 250, Type 3R.
2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

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

3.2 CONCRETE BASES

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

B. Concrete base is specified in Division 16 Section "Electrical Supports and Seismic Restraints," and concrete materials and installation requirements are specified in Division 3.

3.3 INSTALLATION

A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

C. Comply with mounting and anchoring requirements specified in Division 16 Section "Electrical Supports and Seismic Restraints."

D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 16 Section "Electrical Identification."

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Prepare for acceptance testing as follows:
   1. Inspect mechanical and electrical connections.
   2. Verify switch and relay type and labeling verification.
   3. Verify rating of installed fuses.
   4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.

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

D. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

E. Perform the following field tests and inspections and prepare test reports:
   1. Test mounting and anchorage devices according to requirements in Division 16 Section "Electrical Supports and Seismic Restraints."
   2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
   3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
   4. Infrared Scanning:
      a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Open or remove doors or panels so connections are accessible to portable scanner.
      b. Follow-Up Infrared Scanning: Perform an additional follow-up infrared scan of each unit 11 months after date of Substantial Completion.
      c. Instruments, Equipment and Reports:
         1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
         2) Prepare a certified report that identifies enclosed switches and circuit breakers included and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.7 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 16410

SECTION 16442

PANELBOARDS
(Filed Sub-Bids Required)

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 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: E-001, E-002, E-111, E-121, E-131, E-141.

B. Sub-sub Bids are not required for this trade.

1.3 SUMMARY

A. Section Includes:
1. Lighting and appliance branch-circuit panelboards.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:
1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handle and prepare panelboards for installation according to NEMA PB 1.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
   1. Notify Owner no fewer than two days in advance of proposed interruption of electric service.
   2. Do not proceed with interruption of electric service without Owner's written permission.
   3. Comply with NFPA 70E.

1.8 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Enclosures: Surface-mounted cabinets.
   1. Rated for environmental conditions at installed location.
      a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
   3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
   4. Finishes:
      a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
      b. Back Boxes: Same finish as panels and trim.
   5. Directory Card: Inside panelboard door, mounted in transparent card holder.

B. Incoming Mains Location: Top or bottom.

C. Phase, Neutral, and Ground Buses:
   1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
   2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

D. Conductor Connectors: Suitable for use with conductor material and sizes.
   1. Material: Tin-plated aluminum or Hard-drawn copper, 98 percent conductivity.
   2. Main and Neutral Lugs: Mechanical type.
   3. Ground Lugs and Bus-Configured Terminators: Mechanical type.

E. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

F. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
   2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
   3. Siemens Energy & Automation, Inc.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Mount top of trim 90 inches above finished floor unless otherwise indicated.

C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

D. Install overcurrent protective devices and controllers not already factory installed.

E. Install filler plates in unused spaces.

F. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 16 Section "Electrical Identification."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final circuit designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 16 Section"Electrical Identification."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 16 Section "Electrical Identification."

3.4 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 16442

SECTION 16511

INTERIOR LIGHTING
(Filed Sub-Bids Required)

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 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.

1. The Work of this section is shown on Drawings: E-001, E-002, E-111, E-121, E-131, E-141.

B. Sub-sub Bids are not required for this trade.

1.3 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, and LED drivers.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

B. Related Sections:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.4 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. Lumen: Measured output of lamp and luminaire, or both.

D. Luminaire: Complete lighting fixture, including ballast housing if provided.

E. LED: Light Emitting Diode

1.5 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. LED drivers.
4. Energy-efficiency data.
5. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

    a. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. FM Global Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

1.7 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

E. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

   a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
   b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

2.3 LED LIGHT FIXTURES

A. General:

1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.
2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.
3. LED drivers shall include the following features unless otherwise indicated:
   a. Minimum efficiency: 85% at full load.
   b. Minimum Operating Ambient Temperature: -20˚ C. (-4˚ F.)

c. Input Voltage: 120 - 277V (±10%) at 60 Hz.

d. Integral short circuit, open circuit, and overload protection.

e. Power Factor: ≥ 0.95.

f. Total Harmonic Distortion: ≤ 20%.

g. Comply with FCC 47 CFR Part 15.

4. LED modules shall include the following features unless otherwise indicated:

a. Comply with IES LM-79 and LM-80 requirements.

b. Minimum CRI 80 and color temperature 3500˚ K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.

c. Minimum Rated Life: 50,000 hours per IES L70.

d. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.

B. LED Downlights:

1. Housing, LED driver, and LED module shall be products of the same manufacturer.

C. LED Troffers:

1. LED drivers, modules, and reflector shall be accessible, serviceable, and replaceable from below the ceiling.

2. Housing, LED driver, and LED module shall be products of the same manufacturer.

2.4 EXIT SIGNS

A General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B Internally Lighted Signs:

Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.

3. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

a. Battery: Sealed, maintenance-free, nickel-cadmium type.

b. Charger: Fully automatic, solid-state type with sealed transfer relay.

c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.

e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.5 LIGHTING FIXTURE SUPPORT COMPONENTS

1. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

2. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

PART 3 EXECUTION

3.1 INSTALLATION

1. Lighting fixtures:

a. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
b. Install lamps in each luminaire.

2. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

3. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.

a. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
b. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
c. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
d. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

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

B. IDENTIFICATION

1. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

C. ADJUSTING

1. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

a. Adjust aimable luminaires in the presence of Architect.

END OF SECTION 16511

SECTION 16521

EXTERIOR LIGHTING
(Filed Sub-Bids Required)

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 FILED SUB-BIDS

A. Sub-bids shall be submitted for the Work of this Section in accordance with the provisions of M.G.L. c. 149A §§ 1-13. The time and place for submission of sub-bids are set forth in the ADVERTISEMENT. The procedures and requirements for submitting sub-bids are set forth in the INSTRUCTIONS TO BIDDERS.
   1. The Work of this section is shown on Drawings: E-001, E-002, E-111, E-121, E-131, E-141.

B. Sub-sub Bids are not required for this trade.

1.3 SUMMARY

A. Section Includes:

   1. Exterior luminaires with lamps and ballasts.

1.4 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. LER: Luminaire efficacy rating.

D. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.5 SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
6. Ballasts, including energy-efficiency data.
7. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.

B. Warranty: Sample of special warranty.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with IEEE C2, "National Electrical Safety Code."

C. Comply with NFPA 70.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

2.2 FLUORESCENT BALLASTS AND LAMPS

A. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F and Higher: Electronic type rated for 0 deg F starting and operating temperature with indicated lamp types.
2. Temperatures Minus 20 Deg F and Higher: Electromagnetic type designed for use with indicated lamp types.

B. Ballast Characteristics:

1. Power Factor: 90 percent, minimum.
2. Sound Rating: Class A.
3. Total Harmonic Distortion Rating: Less than 10 percent.
4. Case Temperature for Compact Lamp Ballasts: 65 deg C, maximum.
5. Transient-Voltage Protection: Comply with IEEE C62.41.1 and IEEE C62.41.2, Category A or better.

C. Low-Temperature Lamp Capability: Rated for reliable starting and operation with ballast provided at temperatures minus 20 deg F and higher.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

A. Install lamps in each luminaire.

B. Fasten luminaire to indicated structural supports.

3.2 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION 16521