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# Rehabilitation of Mufti Hassan Khaled Garden Beirut - Lebanon

## TENDER DOCUMENTS

### Technical Specifications

Part 3 of 4  
Mechanical Works

August 2024

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## SECTION 15010

### BASIC MECHANICAL REQUIREMENTS

#### 1 - GENERAL

##### 1.01 SUMMARY

- A. This section generally specifies administrative and procedure requirements regarding mechanical work. Additional requirements are specified in various sections of Division 16 and also may be required during the execution work due to project conditions.
- B. The requirements of this Section do not supersede or take precedence over any provision of the General Conditions and Supplementary General Conditions, and should any discrepancy become apparent between these requirements and the General Conditions and Supplementary General Conditions, the Contractor shall notify the Engineer, in writing, and the Engineer shall interpret and decide such matters in accordance with the applicable provisions of the General Conditions and Supplementary General Conditions.
- C. **Extent of Work**  
The Contractor shall supply all labor, materials, equipment, tools, appurtenances, storage, services and temporary work, necessary to completely install, in accordance with these specifications and the drawings, the following mechanical installation of the project.
- Domestic water systems.
  - Irrigation water systems.
  - Storm and waste drainage systems.

#### IMPORTANT NOTE:

Work, materials, equipment or services not specifically mentioned or implied in other clauses of these specifications or elsewhere, or indicated on the drawings but found necessary for the completion and perfect functioning of the installations must be included in the Contractor's price.

The work shall include also operation of the installations after completion and acceptance including maintenance and guarantee of the works as described hereinafter.

The work shall be designed and carried out in accordance with the contract drawings and specifications as well as the standards of the country of origin.

The following builder's work shall be considered as part of this work:

1. Concrete foundations and pads under pumps, filters, reservoirs and other equipments.
2. All Builder's work in connection with fixing supports, hangers, anchors, etc.
3. Cutting or forming all openings, mortar, chases, etc., in floors, walls and ceilings required for the installation and making good after.
4. Painting items of equipment and exposed pipes and supports.
5. Labeling.

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## 1.02 QUALITY ASSURANCE

- A. Materials and equipment shall conform to the latest edition of reference specifications specified herein and to applicable codes and requirements of local authorities having jurisdiction.
1. Reference Standards
    - a. Provide materials and equipment listed by Underwriters' Laboratories, Inc. except in those cases where an Underwriters' Laboratories listing is not available.
    - b. Comply with the latest applicable standards of the following:
      1. American Plumbing code.
      2. UL - Under Writer's Laboratories.
      3. British Standards.
- B. Locally manufactured products of same make and same quality could be approved by the Engineer, however the Engineer shall be the sole judge to determine whether the product is of the same quality or not.

## 1.03 SUBMITTALS

- A. Definitions: The required submittals of this division, in addition to the definitions of the General Conditions, and elsewhere in the contract documents, are further categorized for convenience as follows.
- B. Product data shall include manufacturer's latest standard printed literature such as manufacturer's installation instructions, catalog cuts, color charts, roughing diagrams, wiring diagrams and performance curves on materials, equipment and systems for this project. Product data shall include references to applicable specification section and item number. Product data shall be provided in addition to the required shop drawing submittals.
- C. Shop drawings and as built drawings shall submit to Engineer for Approval as described hereinafter.
- D. Samples shall include physical examples of materials in complete units for visual inspection. Samples shall indicate applicable specification section number and item numbers within that section.

## 1.04 INTENT

The purpose of the drawings and specification is to provide an approach for intended complete installations, finished, fully adjusted, tested commissioned and put in perfect operating condition. The spirit as well as the letter of the drawings and specification shall be followed, and all work shall be executed according to the true intent and meaning of the drawings and specification.

## 1.05 DISCREPANCIES AND OMISSIONS

It is the responsibility of the Contractor, to inform the Engineer of any discrepancies in the drawings and specifications before signing the Contract, default of which will make him

responsible for any errors or omissions in the drawings and specifications even though these have been approved by the Engineer.

All costs incurred by any changes or alterations necessitated by any errors or omissions shall be on the Contractor's own expense without having the right to ask the employer for any indemnity.

#### 1.06 ENGINEER'S DRAWINGS

The Engineer's drawings are generally diagrammatic and include general layouts and typical details of the various systems to be installed. No deviations from the drawings shall be made without receipt of prior written approval from the Engineer.

The drawings shall not be scaled. The Contractor shall base all measurements both horizontal and vertical from established bench marks. All work shall agree with these established lines and levels. All measurements shall be verified on Site and checked as to correctness of same as related to the work.

The Contractor shall check all the Architectural, Structural and Electrical drawings in laying out work for verifying the adequacy of space in which work will be installed. Maximum headroom and space conditions shall be maintained at all points. Where headroom or space conditions appear inadequate the Engineer shall be notified before proceeding with installation.

#### 1.07 SHOP AND INSTALLATION DRAWINGS

Prior to starting the work the Contractor shall submit to the Engineer for approval detailed shop and installation drawings showing to scale dimensions of equipment, pipes, etc. in plan and elevation with clearances and relation of same to the space assigned.

Where the work will be installed in close proximity to, or will interfere with the work of other trades, the Contractor shall coordinate space conditions to make a satisfactory adjustment. The Contractor shall prepare composite installation drawings and sections to a suitable scale of not less than 1/50, clearly showing how work will be installed in relation with work of other trades.

Prior to submissions of the drawings and approximately 30 days after award of the Contract, the Contractor shall submit lists of all equipment and materials with the names of proposed manufactures. Lists shall show submission dates. The drawings will not be accepted prior to submission of such lists. Drawings of interrelated items shall be submitted at approximately the same time.

Drawings of equipment and material shall include detailed manufacturer's drawings, cuts of catalogues and descriptive literature, showing specifications, type, performance characteristics, construction, component parts, dimensions, size, arrangement, operating clearances, capacity, electrical characteristics, power requirements, motor, drive and testing information. Data of a general nature will not be accepted.

Catalogues, pamphlets or manufacturers' drawings submitted for approval shall be clearly marked in ink for proper identification of the item being proposed.

Deviations from the specifications and the drawings shall be indicated clearly with the reason for each deviation.

All submissions for approval shall be furnished in three copies and submitted sufficiently in advance of requirements to allow the Engineer ample time for checking and approving. Failure of the Contractor to submit the drawing in ample advance time shall not entitle him to an extension of contract time, and no claim for extension by reason of such default will be allowed.

No equipment or material shall be purchased, delivered to the Site or installed until the contractor has in his possession the approved drawings for the particular equipment or material.

Approval rendered on drawings shall not relieve the Contractor from his responsibility to provide equipment and material to meet the performance and quality standards as indicated on the drawings and as described in the specification or be of physical size to fit the space assigned for it.

Material not covered by drawings such as pipe, fitting and incidentals shall be submitted for approval in letter form giving ratings and names of manufacturers.

During the progress of the work drawings shall be submitted as required by the Engineer and as specified elsewhere in this specification. These drawings shall comprise but not necessarily be limited to concrete bases for equipment with location of anchor bolts, manufacturers' certified installation drawings and instructions, certified performance characteristics of equipment, wiring diagrams of motor controllers and control systems, etc.

Where required by the Engineer the Contractor shall submit for approval samples of material to be used and workmanship proposed. The Contractor shall not use material or workmanship that does not correspond to the approved samples.

#### 1.08 COORDINATION WITH OTHER TRADES

The Contractor shall plan and coordinate the work with all other trades in advance of requirements and shall provide all necessary resources to ensure compliance with the construction program.

The Contractor shall coordinate the space requirements of all other trades involved and shall be responsible for the sufficiency of the size of shafts and chases and the adequate clearance in double partitions, hung ceilings, etc. for the proper installation of the work.

The Contractor shall give full cooperation to all other trades to permit the work of the trades to be installed satisfactorily and with the least possible interference or delay.

The Contractor shall furnish to other trades, as required, all necessary templates, patterns, setting plans and shop details for the proper installation and coordination of adjacent work.

The Contractor shall undertake to make, without extra charge, minor changes and modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

Any extra cost incurred by lack of coordination on the part of the Contractor shall be at his own expense.

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## 1.09 RECORD DRAWINGS

The Contractor shall submit to the Engineer for record a complete set of as-built drawings and electrical wiring diagrams, in hard copies and on CD on the latest version of AutoCad in “dwg” extension format, reflecting all the changes made from the original drawings during the progress of the work. The drawings and electrical wiring diagrams shall show all labeled equipment, valves, controls, instruments and electrical devices.

## 1.10 INSTRUCTION MANUALS AND SPARE PARTS LISTS

The Contractor shall furnish four copies of an instruction manual bound in booklet form containing the following information:

Brief description of every system and equipment with basic operating features.

Descriptive literature of all equipment and components with manufacturer's name, model number, capacity rating and operating characteristic.

Service manual for every major piece of equipment giving operating and maintenance instructions, starting and shutdown instructions, lubrication instructions and possible breakdown and repairs. The service manual shall be prepared specially by the manufacturer for the particular equipment.

Manufacturer's list of general spare parts for every piece of equipment with unit prices.

Manufacturer's list of recommended spare parts for one year of operation for every piece of equipment with unit prices.

Detailed and simplified one line, color coded flow diagram of every system with tag number, location and function of each valve and instrument.

The instruction manual shall be submitted in draft form to the Engineer for his review and approval as to the fulfillment of the specified requirements prior to final issue.

The instruction manual shall be submitted to the Engineer at least four weeks in advance of the complete date of the system to be available for the final inspection prior to acceptance of the respective systems.

## 1.11 DELIVERY, STORAGE AND HANDLING

Deliver products to the project properly identified with name, model number, types, grades, compliance labels and other information needed for identification.

## 1.12 EQUIPMENT AND MATERIAL QUALITY WORKMANSHIP

All equipment and material provided by the Contractor shall be new, free from defects and of the same type, standard and quality as set forth in the specification.

Equipment and material of similar application shall be of the same manufacturer unless otherwise specified.

All workmanship shall be of the highest standard of the industry, of accepted engineering practice and to the entire satisfaction of the Engineer. Poor workmanship shall be rejected and the work reinstalled when, in the judgment of the Engineer, the workmanship is not of the highest quality.

### 1.13 SUBSTITUTION OF EQUIPMENT AND MATERIAL

Reference in the drawings and specifications to any equipment or material by name, make or catalogue number, as well as any list of approved manufacturers, shall be interpreted as establishing a standard of quality and performance and shall not in any way be construed as an intention to eliminate the products of other manufacturers and suppliers having approved equivalent products.

Approval of a manufacturer does not necessarily constitute approval of his equipment as equal to those specified. After award of Contract and before start of construction the Contractor shall submit for the approval of the Engineer a complete summary of proposed equivalent to be furnished indicating service, manufacturer, figure number, type and pressure rating.

The Tender shall be based on the trade name and catalogue reference named in the specification and products of the approved manufacturers. Should the Contractor wish to use any equipment, material or products other than those specified he should so state as an alternative to the Tender, naming the proposed substitutions and indicating what difference, if any, will be made to the Contract Price and detailing all differences entailed by the substitution.

At all times the Engineer shall be the only judge of equality between the proposed alternative and the item specified. No alternative shall be implemented without the written approval of the Engineer.

Where the Contractor proposes to use equipment other than that specified or indicated which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the works, all such redesign, new drawings and detailing required shall be prepared by the Contractor at his own expense. All additional costs resulting from such substitution if approved by the Engineer in writing, shall be paid by the Contractor.

Where such approved substitution requires a different quantity or arrangement of piping, wiring, conduit and equipment from that specified or shown on the drawings the Contractor shall provide all such piping, structural supports, insulation, controllers, motors, starters, electrical wiring and conduits and any other additional equipment required by the system, at no additional cost to the Employer.

### 1.14 PROTECTION

The Contractor shall order all equipment from the manufacturer specifying adequate packing for export at the factory to avoid damage during shipment to the Site.

The Contractor shall be responsible for safe storage and the adequate protection of all material and equipment until finally installed, tested and accepted.

He shall protect work against theft, injury or damage and shall carefully store material and equipment received on Site in their original crates or containers until they are installed. This responsibility shall embrace any delay pending final testing of systems and equipment due to any condition.

The Contractor shall close open ends of work with temporary covers or plugs during construction and storage to prevent entry of obstructing material.

The Contractor shall coordinate the protection of the work of all trades and shall be liable for any damage sustained to other trades resulting from his work.

If any equipment is damaged during shipment or before it is tested and accepted, the Contractor shall replace or repair the equipment, depending on the extent of damage and as determined and decided by the Engineer, on the Contractor's own account and without additional cost to the Employer.

#### 1.15 ACCESSIBILITY

Contractor shall be responsible for determining in advance of purchase that equipment and materials proposed for installation shall fit into the confines indicated areas, allowing adequate space for maintenance.

All work shall be installed so as to be readily accessible for operation, maintenance and repair. Deviations from the drawings may be made to accomplish this, after the written approval of the Engineer.

Concealed valves and devices shall be grouped together in as practical a way as possible in order to be accessible through access doors.

#### 1.16 ACCESS DOORS

The Contractor shall arrange for access doors and frames to be provided for easy access to concealed equipment, controls, valves, traps, vents, drains, cleanout and other devices that require periodic operation, inspection or maintenance.

However, the dimensions and locations of access doors shall be the responsibility of the Contractor and shall have the approval of the engineer before the work is installed.

Requirements of access doors shall be submitted in sufficient advance time to be installed in the normal course of the work.

The Contractor shall be responsible for the correct identification of access doors by means of buttons, tabs or markers to indicate the location of concealed work. The method and schedule for identification of access doors shall be approved by the Engineer.

#### 1.17 NAMEPLATES

Each piece of equipment provided shall carry, at a conspicuous location, attached in a permanent manner to the equipment at the factory, a certified nameplate on which shall be printed or stamped clearly the name and address of the manufacturer, the equipment model number, serial number, date of manufacture, electrical characteristics, performance rating or duty, pressure, temperature or other limitations and all other pertinent data as deemed necessary by the manufacturer for any future reference to the equipment.

#### 1.18 LABELING

The Contractor shall label and identify all equipment, instruments, controls, electrical devices, valves, etc. as to duty, service or function.

Labels on equipment shall be of laminated bakelite with black surface and white core, with incised lettering nomenclature written in English.

Labels shall be attached to equipment, instruments, controls, electrical devices, etc. or to adjacent permanent surfaces, in an approved permanent manner.

The Contractor shall submit to the Engineer for his approval prior to installation a schedule of all equipment and devices to be labeled and the suggest nomenclature.

Controls and electrical devices shall be labeled to indicate clearly which equipment they control.

#### 1.19 GUARANTEE

The Contractor shall guarantee that the materials and workmanship of the works installed by him under these specifications are first-class in every respect and that he will make good any defect, not due to ordinary wear and tear or improper use or care, which may develop within one year from date of completion.

#### 2 - PRODUCTS (Not Applicable)

#### 3 - EXECUTION

##### 3.01 EXAMINATION

Examine conditions at the job site where Mechanical Work is to be performed to insure proper arrangement and fit of the work. Start of work implies acceptance of job site conditions.

##### 3.02 PREPARATION

The Engineer's drawings issued with these specifications show the approximate location of mechanical apparatus; the exact locations are subject to the approval of the Engineer.

##### 3.03 INSTALLATION

- A. Sequence, coordinate and integrate the various elements of mechanical systems, materials and equipment. Comply with the following requirements.
- B. Coordinate mechanical systems, equipment and material installation with other building components.
- C. Verify dimensions by field measurements.
- D. Arrange for chases, slots and openings in other building components during progress of construction, to allow for electrical installations.
- E. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

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- F. Sequence, coordinate and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
- G. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
- H. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies and controlling agencies. Provide required connection for each service.
- I. Install systems, materials and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
- J. Install systems, materials and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
- K. Install mechanical equipment to facilitate servicing, maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- L. Install access panels or doors where units are concealed behind finished surfaces. Access panels and doors are specified in Section 15050 - "Basic Mechanical Materials and Methods."
- M. Install systems, materials and equipment giving right-of-way priority to systems required to be installed at a specified slope.
- N. Painting
1. Follow manufacturer's recommendations for surface preparation and application procedures for paints and finishes.
  2. Thoroughly clean surfaces requiring prime painting of rust, loose scale, oil, grease and dirt by the use of wire brushes, solvent and other required means.
  3. Do not paint on damp or frosty surfaces or during wet, foggy or freezing weather.
  4. Spread and brush paint evenly to eliminate drips, runs or sagging.
  5. Fill voids, open or hollow places and irregularities with compound.
  6. Thoroughly clean and retouch damaged or dirtied shop coat surfaces.
  7. Do not paint controls, nameplates or labels.
  8. Paint thickness are as measured when dry.
  9. Machinery: Before shipment, paint machinery including fans, compressors, pumps and motors with the manufacturer's standard shop prime coat.
  10. Piping

Prime coat steel and cast iron piping and related pipe supports, immediately after installation, regardless of whether or not they will be subsequently covered with insulation and/or finish painted. Apply prime coat in accordance with manufacturer's specifications. Do not prime galvanized metals.

O. Cutting and Patching

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

3.05 FIELD QUALITY CONTROL

A. Tests

1. Perform tests on individual equipment, systems and controls in the presence of the Representatives of the Employer, Engineer and such other parties as may have legal jurisdiction.
2. Supply labor, materials, properly calibrated instruments, power, etc., required for testing, unless otherwise indicated.
3. Before conducting any tests on system or equipment, thoroughly clean the associated systems or equipment just prior to testing.
4. Test equipment and systems which normally operate during certain seasons during the appropriate seasons. Where the equipment or system under test is interrelated with and depends upon other equipment, systems, and/or controls for proper operation, functioning and performance, operate the latter simultaneously with the equipment or system under test.
5. The duration of tests shall be as determined by authorities having jurisdiction, but in no case less than the time prescribed in each section of the specifications.
6. In general, apply pressure tests to piping only, before connection of fixtures, equipment and appliances. Do not subject any piping, fixtures, equipment or appliances to pressures exceeding their test rating.

7. Promptly repair or replace defective work and repeat the tests until the particular system and component parts thereof receive the approval of the Engineer. Replace or replace any damages resulting from tests, as directed by the Engineer.
8. Submit test records on reproducible sheets to the Engineer for approval and include approved copy in the Instruction Manual. The Engineer shall approve the format of the record sheet prior to actual testing of equipment.
9. During tests of equipment and system, fully instruct the Employer's representatives on the operation and maintenance of the equipment and systems. This period is in addition to any required special instruction, elsewhere specified.

**B. Final Inspection**

1. At final inspection, it is essential that certain trades be properly represented including the following:
  - a. Mechanical Contractor including people thoroughly familiar with the project, its intent, equipment and system installation and operation.
  - b. Air conditioning equipment manufacturer.
  - c. The automatic control manufacturer representatives familiar with the installation who can demonstrate to the Employer's satisfaction that the controls perform according to the specified requirements.
  - d. The Electrical Contractor's, representatives familiar with the installation's wiring and interlocking.
2. The Mechanical Contractor shall verify the actual operation of equipment and controls prior to final inspection.

**3.06 CLEANING, ADJUSTING AND BALANCING - GENERAL**

- A. Thoroughly clean any apparatus before placing in operation. Restore finished surfaces if damaged and deliver the entire installation in an approved condition.
- B. Adjust and balance systems to operate as shown and specified.

**3.07 MAINTENANCE OF EQUIPMENT AND SYSTEM PRIOR TO FINAL ACCEPTANCE**

- A. Take necessary measures to insure adequate protection of equipment and materials during delivery, storage, installation and shutdown conditions. This responsibility shall include provisions required to meet the conditions incidental to the delays pending final test of systems and equipment under seasonal conditions.
- B. Operate the completed systems for a period of time prescribed by the Engineer to determine the capability of the equipment and controls to conform to the requirements of the drawings and specifications.
- C. Maintenance period for mechanical works shall be 365 days from the date of issuance of taking over certificate.
- D. Make final operating tests with systems in simultaneous operation and building in normal operating modes.

### 3.08 DEMONSTRATION AND INSTRUCTION

The Contractor shall provide the services of the representatives of the control manufacturer and the Electrical Subcontractor for Employer's Representative instruction purposes, for a total period of seven, 8 hour days. This period shall follow the final inspection date and shall not necessarily consist of a single series of consecutive days. Apportion time between summer, winter and intermediate operating seasons as mutually agreed.

END OF SECTION

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## SECTION 15050

### BASIC MECHANICAL MATERIALS AND METHODS

#### 1 - GENERAL

##### 1.01 SUMMARY

- A. Provide labor, materials, equipment and services, and perform operations required for complete installation of the works related to this section as indicated on the drawings and specified herein.
- B. Work Included: The work shall include, but not be limited to, the following:
1. Excavation for underground utilities and service
  2. Miscellaneous metals for support of mechanical materials and equipment.
  3. Access panels and doors in walls, ceilings and floors for access to mechanical materials and equipment.
  4. Mechanical equipment nameplate data.

##### 1.02 QUALITY ASSURANCE

Materials & equipment shall conform to the latest edition of reference specifications specified herein and to applicable codes and requirements of local authorities having jurisdiction.

##### 1.03 SUBMITTALS

- A. Submit the following submittals in accordance with Section 15010 "Basic Mechanical Requirements."
- B. Provide product data for the following products:
1. Access panels and doors.
  2. Joint sealers.
  3. Pipe and duct sleeves.
- C. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for mechanical materials and equipment.
- D. Coordination drawings for access panel and door locations in accordance with Section 15010 "Basic Mechanical Requirements."
- E. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shutoff of utility service, and details for dust, fire and noise control. Coordinate sequencing with construction phasing and Employer occupancy specified in the Contract Documents.

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## 1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver joint sealer materials in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time and mixing instructions for multi-component materials.
- B. Store and handle joint sealer materials in compliance with the manufacturer's recommendations to prevent their deterioration and damage.

## 2 - PRODUCTS

### 2.01 MATERIALS

- A. Mechanical Equipment Nameplate Data
  - 1. Nameplate: For each piece of mechanical equipment provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location, as approved by Engineer.
  - 2. Relocate nameplates as required and approved after installation to permit easy reading.
- B. Sealant
  - 1. Provide ready-to-use silicone penetration seal that will stop passage of fire, smoke, and water. Sealant will cure in the presence of atmospheric moisture to produce durable and flexible seal, and will form airtight and watertight bonds with most common building materials in any combination including cement, masonry, steel, and aluminum.
  - 2. Sealant Composition shall be one-part ready-to-use materials with consistency of soft caulk at temperatures ranging from -35 to 160 F, and extension and compression properties of plus/minus 40% of original gap.
- C. Access Doors
  - 1. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
  - 2. Frames: 16-gauge steel, with a 1 inch wide exposed perimeter flange for units installed in unit masonry, precast or cast-in-place concrete, ceramic tile or wood paneling.
    - a. For Installation in Masonry, Concrete, Ceramic Tile, or Wood Paneling: 1 inch wide exposed perimeter flange and adjustable metal masonry anchors.
    - b. For Full-Bed Plaster Applications: Galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.

## 3 - EXECUTION

### 3.01 EXAMINATION

Examine conditions at the job site where work of this section is to be performed to insure proper arrangement and fit of the work. Start of work implies acceptance of job site conditions.

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### 3.02 PREPARATION

- A. Examine the Contract Drawings and specifications in order to insure the completeness of the work required under this Section.
- B. Verify measurements and dimensions at the job site and cooperate in the coordination and scheduling of the work of this Section with the work of related trades, so as not to delay job progress.
- C. Provide templates as required to related trade for location of support and anchorage items.
- D. Preparation for Joint Sealers
  - 1. Thoroughly clean surfaces, removing foreign matter such as dust, oil, grease, water, surface dirt and frost. Materials must be applied to the base surface.
  - 2. Prior to any priming and sealing, joints shall be masked by masking tape or other approved means to prevent soiling of adjacent surfaces.
  - 3. Immediately prior to application of materials test adhesion of materials to each substrate material and apply primer to any surface showing poor adhesion.
  - 4. Where required support material with damming materials specified herein. Where sealant materials require damming provide duct tape or compatible backer rod.

### 3.03 INSTALLATION, ERECTION AND APPLICATION

- A. Erection of Metal Supports and Anchorage
  - 1. Cut, fit and place miscellaneous metal fabrications accurately in location, alignment and elevation to support and anchor electrical, plumbing and HVAC materials and equipment.
  - 2. Attach to substrates as required to support applied loads.
- B. Installation of Access Doors
  - 1. Set frames accurately in position and securely attach to supports, with face panels plumb and level in relation to adjacent finish surfaces.
  - 2. Adjust hardware and panels after installation for proper operation.
  - 3. Location
    - a. Locate access doors in hung ceilings, walls, furred spaces, partitions and other components of the structure, where required to service fire dampers, smoke detectors, duct access doors, controls, valves, cleanouts and other items installed under this Division of the specification.
    - b. Contractor shall coordinate the exact location and quantity with mechanical, Engineering and electrical requirements. Access doors are not required in suspended acoustical lay-in tile ceilings unless specifically shown.

### 3.04 FIELD QUALITY CONTROL

- A. Inspect seal after 48 hours for complete adhesion, and seal and correct any deficiencies.
- B. Follow manufacturer's installation instructions precisely, including 4-point field quality control checks which consist of foam color, foam cell structure, snap time, and free foam density.

- C. Inspect seal after 24 hours. Remove damming materials to inspect under site.
- D. Correct any deficiencies by adding foam or sealant. Reinspect after 24 hours.

### 3.05 ADJUSTING AND CLEANING

- A. Clean excess cured sealant from nonporous surfaces with commercial solvent such as naphtha mineral solvents, following instructions on container label.
- B. Clean spills of liquid components with high-flash mineral spirit solvent, following instructions on container label. Trim excess foam with sharp knife or blade.
- C. Remove equipment, materials and debris. Leave area in undamaged, clean condition.

END OF SECTION

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SECTION 15060  
PIPES AND FITTINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Provide labor, materials, equipment and services, and perform operations required for complete installation of the works related to this section as indicated on the drawings and specified herein.
- B. Work Included: The work shall include, but not be limited to, the following:
  - 1. uPVC pipes PN10 for underground cold water pipes.
  - 2. Polyethylene pressure pipes and fittings, PN16, for lateral irrigation pipes.
  - 3. PVC pipes, PN16, for main irrigation pipes.
  - 4. PVC drainage pipes, PN6, for rain water, waste water drainage, and venting systems.
- C. Related Work Specified Elsewhere
  - 1. Section 15010 - Basic Mechanical Requirements.
  - 2. Section 15050 - Basic Mechanical Materials and Methods.

1.2 QUALITY ASSURANCE

- A. Materials shall conform to the latest edition of reference specifications and industry standards specified herein and applicable, and to pertinent codes and requirements of local authorities having jurisdiction.
- B. Manufacturer's Qualifications: Firms regularly engaged in manufacture of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.3 SUBMITTALS

- A. Submit the following in accordance with requirements specified under submittals in section 15010.
- B. Product Data
  - 1. Submit copies of manufacturer's latest published literature for each type of pipe and pipe fitting specified herein for approval. Obtain approval before ordering materials.
  - 2. Data shall include piping schedule showing manufacturer, pipe or tube weight, fitting type, and joint type for each piping system.
- C. Certificates: Submit certificates attesting to compliance with these specifications to Engineer for approval. Obtain approval prior to ordering materials.
- D. Maintenance Data: Submit maintenance data and parts lists for each type of mechanical fitting. Include this data, product data, and certifications in maintenance manual, as approved.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Except for concrete, corrugated metal, hub-and-spigot, clay, and similar units of pipe, provide factory-applied plastic end caps on each length of pipe and tube. Maintain end caps through shipping, storage and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.
- B. Where possible, store pipe and tube inside; protect from weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.
- C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

### PART 2 PRODUCTS

#### 2.1 MATERIALS/EQUIPMENT

- A. Unplasticized Poly Vinyl Chloride (uPVC) Plastic Pipes, Fittings and Joints: BS-EN 1401-1; inside nominal diameter as shown on drawings.
- B. Galvanized welded steel pipes and fittings shall be according to DIN 2440 medium class.
- C. Multilayers PEX/aluminum/PEX shall be according to DIN 16892.
- D. Polypropylene pipes and fittings shall be according to DIN 8077, 8078, PN20.
- E. Copper pipes shall be seamless, solid drawn, hard copper tube supplied in straight lengths and suitable for connection by means of compression fittings or capillary fittings with solder brazing and complying with British standard 2871: Part 1, Table Y.
  - 1. Fittings used for copper pipe shall be wrought copper of the capillary end feed solder type and shall conform to British Standard 864, Part 2. Fittings used for connections to equipment shall be of the non-manipulative compression type conforming to BS 864: Part 2, Type A.
  - 2. All copper pipes when buried, should be factory coated by a tightly extruded plastic on the copper tube in a seamless continuous run.
- F. Black seamless steel pipes and fittings shall be according to DIN 2440 medium class.
- G. PVC drainage pipes shall be of unplasticized polyvinyl chloride with solvent cemented socket joints and complying with NFT54.028 (EN 1329) for pipes inside the toilets and with rubber ring sealed socket joints and complying with "DIN 19534 (EN 1401) for pipes outside the toilets.
- H. Cast iron drainage water pipes shall be according to EN 877.
- I. High density polyethylene drainage pipes shall be according to DIN 8075/19535/19537 with electric welding.

- J. Perforated pipes shall be used for drainage of flower bed and ground floor landscaped area.
  - 1. Pipes shall be made of PVC in accordance with DIN 1187.
  - 2. Pipe shall be corrugated, flexible and slotted all over. Slots to be in the corrugated groove, width to be medium size according to DIN 1187.
  - 3. Pipes to be supplied with filter material made of indestructible coco fiber with plastic wire wrapping.
- K. Copper pipe to be seamless degreased type “L” pipes.
- L. Zinc rain water pipes shall be according to NFP 36-403.
- M. Vitrified clay pipe to be according to ASTM C700, with bell and spigot, neoprene gaskets.

## 2.2 PIPE ACCESSORIES AND FITTINGS

- A. General:
  - 1. The accessories shall be of the same standard as the pipes on which they are fitted, they shall be flanged, threaded or welded depending on the type and the diameter of the pipe and the location in which the pipes are installed.
  - 2. For PVC pipes, all fittings shall be made of PVC from the same series and by the same manufacturer of the pipes.
  - 3. For HDPE pipes, all fittings shall be made of HDPE from the same series and by the same manufacturer of the pipes.
- B. Unions and Flanges:
  - 1. Unions and flanges shall be installed at all equipment inlets and outlets, at all valve inlets or outlets, on all pipe branches and in general, at every 15 meters of pipe run.
  - 2. Unions shall be used on all screwed pipes and shall be of the same quality and service.
- C. Pipe Sleeves:
  - 1. Pipe sleeves shall be supplied and installed wherever pipes cross slabs, walls partitions, ceilings, floors, etc.
  - 2. For pipe sleeves passing from a fire zone compartment to another, foam should be used having the same fire rating as fire zone compartment.
  - 3. Sleeves shall be cut of galvanized steel pipe of approved weight, having an internal diameter of not less than 1cm larger than the bare sleeved pipe or the insulated sleeved pipe depending on the particular condition. Sleeves shall be of material compatible with the pipes they protect.
  - 4. Sleeves passing through wall partitions and ceiling shall terminate flush with finished wall or ceiling surface.
  - 5. Sleeves passing through floor shall extend 5cm above the finished floor level.
  - 6. Sleeves passing through roof shall extend 15cm above the finished surface and shall be provided with a 1mm lead flashing to prevent roof water penetration.
  - 7. All gaps shall be plugged with a non-flowing, plastic and waterproof mastic paste.

- D. Strainers:
1. Strainers shall be of Y-type, bronze construction with stainless steel screen, designed for servicing without being dismantled from the pipe and suitable for 10bar working pressure.
  2. Strainers shall be installed at the inlets of pumps as shown on drawings.
- E. Expansion Joints:
1. Expansion joints shall be of the rubber or stainless steel bellow type suitable for 10 bars working pressure. The connection shall be in accordance with the pipe material.
  2. The type, number and location of the expansion joints shall be approved by the Engineer.
- F. Pipe Guides:
1. Pipe guides shall be used before or after expansion joints, the other side of the pipe being properly anchored. The guides shall be of a standard construction approved by the Engineer.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions at the job site where work of this section is to be performed to insure proper arrangement and fit of the work. Start of work implies acceptance of job site conditions.

### 3.2 PREPARATION

- A. Examine the Contract Drawings and specifications in order to insure the completeness of the work required under this Section.
- B. Verify measurements and dimensions and check all capacities at the job site and cooperate in the coordination and scheduling of the work of this Section with the work of related trades, so as not to delay job progress.

### 3.3 INSTALLATION

- A. Pipeline Slopes:
1. Horizontal pipelines shall have the following slopes, unless otherwise indicated by the Engineer.
    - a. All water supply and water distribution: 0.2% to 0.5%.
    - b. Soil, waste and rain water drains: 1% to 2%.
- B. General Requirements for Pipe Installation:
1. All pipes shall be installed in straight parallel lines.
  2. Pipes shall be spaced to permit their installation, maintenance and insulation.
  3. Pipes shall be spaced to permit their installation, maintenance and insulation.
  4. Concealed pipes shall be installed in such a way as to permit their maintenance and inspection.
  5. All pipes shall be so installed as to ensure easy and even flow of the water to and from all equipment and fixtures.

6. Pipelines shall be installed in a manner to allow for easy air escape and system draining. It shall be endeavored to obtain this naturally by gravity.
7. However, where this cannot be met, provision should be made to ensure quick and positive drainage and noiseless air discharge.
8. Automatic air vents shall be installed at all points in the pipelines where air gaps can form and drain valves shall be installed at all low points and at the lowest point of each riser leg and wherever required to permit complete drainage of all lines.
9. Drain pipes shall be joined together in a manner satisfying perfect running condition.
10. Vent pipes shall not be trapped and shall be graded to drip back to waste or soil line.
11. All vents for waste and soil stacks shall extend above the highest point of the roof and shall be equipped with a vent head and cap as specified.
12. Sleeves shall be supplied and installed wherever pipes cross slabs, walls, partitions, etc.
13. Connection of PVC and/or HDPE underground pipes to sump pit shall be made by means of a suitable manhole lining to ensure adequate bonding to the concrete.
14. Clean-outs shall be placed at all changes in direction whether shown on the drawings or not.
15. Copper pipes shall be round, clean, smooth and free from defects and deteriorious films in the bore.

C. Conditions for Pipe Assembly:

1. Before installation, all pipes shall be cleaned of all foreign matter and shall be reamed smooth after cutting. All trenches shall be cleaned up.
2. Pipes shall be carefully cut by hacksaw or by special pipe cutting machine.
3. Steel pipe ends shall be cleaned and smoothed on edge to avoid all roughness and unevenness before welding or threading.
4. Threading shall be done for the total length of joint or accessory with a reliable threading machine.
5. PVC or HDPE pipes when cut, shall be debarred and chamfered according to the instructions of the manufacturer to ensure a proper and easy assembly.
6. All changes in pipe size shall be made with fittings. Eccentric reducing fittings shall be used to prevent pocketing.
7. Change in direction of piping shall be made with long radius fittings.
8. The exposed ends of incomplete or unconnected work shall be plugged. Plugging shall be perfect with gate valves, counter flange plugs or thread plugs.
9. All piping subject to expansion and contraction shall be installed with expansion bends, swing joints made up of fittings or other approved methods or devices. Branch lines from lines subject to expansion and contraction shall have a swing joint at the point of connection with the main. Expansion joints shall be installed even if not shown on the drawings or count for in the bill of quantities.
10. Copper pipes shall be cut perfectly square using a miter box and tube cutter or hacksaw. All burrs shall be removed from both the inside and outside of the tube using a reamer and a file, care being exercised not to expand the pipe while reaming. Both the inside of the fitting cup and the outside of the tube shall be cleaned and burnished to bright metal using wire brush or steel wool.

The tube shall be cleaned to one and a half times the depth of insertion in the cup. Cleaned surfaces shall not be touched with hands or gloves.

- D. Jointing of Galvanized Welded Steel Pipes:
1. Galvanized welded steel pipes shall be jointed with screwed socket joints of adequate materials. Care must be taken to remove any burr from the end of pipes after threading.
  2. All jointing must be done with Teflon.
  3. Any threads exposed after jointing should be painted, or in the case of underground piping, thickly coated with bituminous or other suitable composition to prevent corrosion.
- E. Jointing of Polypropylene Pipes:
1. Polypropylene pipes shall be jointed by electric welding.
- F. Jointing of PEX/Aluminum/PEX Pipes:
1. PEX/ALUMINUM/PEX shall be jointed by press and screw fittings.
- G. Jointing of Seamless Copper Pipes:
1. Joints in copper pipe shall be made by soldering using 95-5 tin-antimony solder or silver brazing as specified under the respective plumbing system concerned. A reliable brand of soldering flux suitable for the application shall be used.
  2. Both the cup of the fitting and the end of the tube shall be thoroughly fluxed spreading the flux evenly over the entire surface and turning the tube inside the fitting to distribute the flux evenly. The tube shall be bottomed inside the fitting to butt against the shoulder inside the cup for aligning the tube and fitting to hold the proper clearance for good soldering and not to leave any gap through which solder can run inside the pipe.
  3. The entire fitting and a portion of the pipe shall be evenly heated with the torch applying the flame does not enter the cup. When the proper brazing temperature is reached the solder shall be touched to the pipe until it melts on contact and is drawn into the cup by capillary action. The flame shall not be directly applied to the solder. Solder shall be continually fed into the joints at one point until a uniform ring of solder appears around the full circumference of the pipe. After the solder has cooled to a plastic state excess solder and flux shall be removed with a cloth or brush leaving a fillet around the cup of the fitting. The completed joint shall be allowed to cold with out disturbance.
  4. Joints between copper pipe and threaded valves and steel pipes shall be made by means of special brass threaded connectors with solder cup at one end threaded to British Standard Taper Pipe Thread at the other end, or by means of copper flanges with solder cup end, depending on the size of pipe. Unions on copper pipes shall have solder cup ends.
- H. Jointing of Black Steel Pipes:
1. Black steel pipes shall be jointed by threading until 2 1/2" and smaller and by welding for larger diameter.
- I. Jointing of PVC Pipes:
1. Solvent weld joints shall be made with the proper solvent cement furnished by the manufacturer for that purpose. Both, the inside of the socket and the

- outside of the spigot end of the pipe shall be roughened using sand paper. All grease and dirt shall be removed from the surface with a special cleaning fluid supplied by the manufacturer. Immediately after cleaning, solvent cement shall be applied and pipe pushed into the socket up to the shoulder without turning.
2. Rubber ring joints shall be made with the proper sealing ring furnished by the manufacturer for that purpose. After the spigot end has been lubricated, it shall be pushed fully into the socket and then pulled out by about 3mm per meter of pipe length (but in no case less than 1cm) to allow for longitudinal thermal expansion.
  3. Cleaning and lubrication shall be as recommended by the manufacturer. No oil or grease should be used.
- J. Jointing of Cast Iron Pipes:
1. Cast iron pipes shall be jointed by a bell & spigot with rubber gasket from the same manufacturer as the pipe.
  2. Cast iron pipes shall be jointed by a bell & spigot with rubber gasket from the same manufacturer as the pipe.
- K. Jointing of High Density Polyethylene Pipes:
1. High density polyethylene pipes shall be jointed by electric butt welding where space permits and with electro-weld sleeve couplings otherwise.
  2. Jointing must be done according to the manufacturer's recommendations and only by a skilled experienced plumber.
- L. Jointing of Perforated Pipes:
1. Pipe coupling to be by tension proof couplings as per DIN 1187.
- M. Jointing of Refrigerant Copper Pipes:
1. Copper pipe to be jointed by silver brazing using 45% silver brazing alloy.
- N. Jointing of Zinc Pipes:
1. Zinc pipes to be jointed by welding.
- O. Jointing of Vitrified Clay Pipes:
1. Vitrified clay pipes to be jointed by a bell and spigot with rubber gasket from the same manufacturer of the pipe.

END OF SECTION

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## SECTION 15100

### VALVES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Provide labor, materials, equipment and services, and perform operations required for complete installation of Valves and related work as indicated on the drawings and specified herein.
- B. Work Included: The work shall include, but not be limited to, the following:
  - 1. Types of valves specified in this section include the following:
    - a. Gate Valves.
    - b. Check Valves.
    - c. Solenoid valves.
    - d. Float Valves.
    - e. Pressure Reducing Valves.
    - f. Water tap.
    - g. Water tap.
    - h. Gate Valves in box.
    - i. Automatic air vents.
    - j. Ball valves.
    - k. Manometers.
    - l. Expansion joints.
    - m. Strainers.
    - n. Union and flanges.
  - 2. Valves furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 15 sections.
- C. Related Work Specified Elsewhere
  - 1. Section 15010 - Basic Mechanical Requirements.
  - 2. Section 15050 - Basic Mechanical Materials and Methods.
  - 3. Section 15110 - Pipes, Fittings and Valves Application.

##### 1.2 QUALITY ASSURANCE

- A. Materials and work shall conform to the latest edition of reference specifications, industry standards listed below and specified herein and to applicable codes and requirements of local authorities having jurisdiction, whichever is more stringent.
- B. Tests: Test valves in accordance with the appropriate section of the specification describing each system.

##### 1.3 SUBMITTALS

- A. Submit the following as specified under Submittals in Section 15010.
- B. Product Data: Submit copies of manufacturer's latest published literature for materials & equipment specified herein for approval; obtain approval before ordering materials.

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#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Exercise proper care in the handling of work so as not to injure the finished surfaces, and take proper precautions to protect the work from damage after it is in place.

### PART 2 PRODUCTS

#### 2.1 MATERIALS/EQUIPMENT

- A. Provide valves of same type by one manufacturer.
- B. Provide valves with manufacturer's name (or trademark) and pressure rating clearly marked on valve body.

#### 2.2 GENERAL

- A. All valves shall be designed for a working pressure of 6 bars.
- B. Valves shall be of the same diameter as the pipe served.
- C. A union shall be used with all gate, check and float valves.

#### 2.3 GATE VALVES

- A. Gate valves shall be designed for working under pressure with valves opened or closed.
- B. Valves shall be of the wedge disc type and shall permit straight line flow and complete shut-off.
- C. The screwed valves shall have joints with B.S. pipe threads. Flanged valves shall have the bolt holes to match the equipment or pipes on which they are installed.
- D. Gate valves used in sanitary works of 2" and smaller shall be brass, with screwed ends, union bonnet, wedge disc.

#### 2.4 CHECK VALVES

- A. Check valves of the silent type shall be used on the discharge side of pumps and whenever shown on the drawings or requested by the Engineer.
- B. Check valves used in sanitary works, of 2" and smaller shall be brass, with screwed ends, screwed cap swing type.

#### 2.5 SOLENOID VALVE

- A. Solenoid valve shall be of bronze body, screwed type, normally closed, controlled by electric float installed in treated water tank as shown on the drawings.

## 2.6 FLOAT VALVES

- A. Float valves shall be of all bronze construction including levers and arms, with PVC float and suitable for a cold water working pressure of 10 bars. Float valves shall have screwed inlets.
- B. Float valves shall be of the full bore, equilibrium ball type, designed to close tight against maximum pressure when half submerged. They shall have renewable synthetic rubber valve discs and balancing piston buckets.

## 2.7 PRESSURE REDUCING VALVES

- A. Pressure reducing valves shall be of the self-contained, direct acting, spring loaded, diaphragm bars type, suitable for inlet pressure of up to 21 bars.
- B. The valves shall be of a design which permits the complete replacement or inspection of any part without removal of the valve body from the pipe.
- C. The valve body shall be of bronze, with threaded ends. The valve trim shall be of bronze and all trim in direct contact with water shall be of bronze or stainless steel. The valve seat shall be of the removable type and shall be of stainless steel. The diaphragm shall be of synthetic rubber. The valve shall be provided from the factory with the correct spring for the outlet pressure range specified. The valve shall be provided with a means for adjusting the outlet pressure within the range of the spring.
- D. The valve shall be suitable for installation in any position.

## 2.8 WATER TAP

- A. All valves shall be of the ball gate valves type.

## 2.9 GATE VALVES IN BOX

- A. Gate valves as specified installed in PVC box to connect to irrigation loop. The box shall be made of PVC with open bottom and green color cover.

## 2.10 AUTOMATIC AIR VENTS

- A. Automatic air vents shall be installed as shown on the drawings and where indicated by the Engineer.
- B. Automatic air vents of the ball float type shall be installed at all high points in the piping systems. They shall support a working pressure up to 10 Kg/cm<sup>2</sup>.
- C. Mechanism of automatic air vent shall be interchangeable.

## 2.11 BALL VALVES

- A. Valve body shall be made of brass with PTFE seal for ball tightness and steel plasticized level.

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## 2.12 MANOMETER

- A. Supply and install all manometer wherever specified in this book of specifications.
- B. Manometer shall be of the bourdon type 4" diameter with protective glass and stop pressure gauge cock. Graduations shall be in psi and kg/cm<sup>2</sup>.

## 2.13 GLOBE VALVES

- A. Globe valves up to 2" inclusive, shall be all brass, screwed ends, union bonnet, metal disk type.

## 2.14 EXPANSION JOINTS

- A. Expansion joints shall be of the rubber or stainless steel bellow type suitable for 6 bars working pressure. The connection shall be screwed.
- B. The type, number and location of the expansion joints shall be approved by the Engineer.

## 2.15 STRAINERS

- A. Shall be with pattern for sizes 2" and smaller with screwed ends, flanged for sizes 2½" and larger.

## 2.16 UNION AND FLANGES

- A. Unions and flanges shall be installed at all equipment inlets and outlets, at all valves inlets or outlets on all pipes branches, to facilitate dismantling, repair or replacement without disturbing piping.
- B. Unions shall be used on all screwed pipes and shall be of the same quality and service. Flanges, suitable for welding, shall be used on all welded pipes, and shall be all steel construction to ASTM or BS. Flanged valves and equipment are connected to the pipes and shall conform to ASTM or BS standards.

## PART 3 EXECUTION

Refer to section 15110 - PIPE, FITTINGS AND VALVES

END OF SECTION

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## SECTION 15110

### PIPE, FITTINGS AND VALVES - APPLICATION

#### 1 - GENERAL

##### 1.01 SUMMARY

A. Provide labor, materials, equipment and services, and perform operations required for complete installation of the works related to this section as indicated on the drawings and specified herein.

B. Work Included: The work shall include, but not be limited to, the following:

This section of the specifications consists of the application of the various types of Pipe, Fittings and Valves as described in Section 15060.

C. Related Work Specified Elsewhere

1. Section 15010 - Basic Mechanical Requirements.
2. Section 15050 - Basic Mechanical Materials and Methods.
3. Section 15060 - Pipes and Fittings.

##### 1.02 QUALITY ASSURANCE

A. Materials and work shall conform to the latest edition of reference specifications and industry standards specified herein and to applicable codes and requirements of local authorities having jurisdiction, whichever is more stringent.

B. Fittings shall have the same wall thickness and schedule as the pipe.

C. Pressure rating of fittings and valves shall exceed highest specified service pressure of the system in which installed.

D. Materials, fittings and valves of any one type shall be from one manufacturer.

#### 2 - PRODUCTS

##### 2.01 MATERIALS/EQUIPMENT

Refer to Section 15060.

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### 3 - EXECUTION

#### 3.01 EXAMINATION

Examine conditions at the job site where work of this section is to be performed to insure proper arrangement and fit of the work. Start of work implies acceptance of job site conditions.

#### 3.02 PREPARATION

- A. Examine the Contract Drawings and specifications in order to insure the completeness of the work required under this Section.
- B. Verify measurements and dimensions and check all capacities at the job site and cooperate in the coordination and scheduling of the work of this Section with the work of related trades, so as not to delay job progress.

#### 3.03 INSTALLATION

- A. Pipe and Fittings
  1. Install pipes and pipe fittings, in accordance with recognized industry practices, which will achieve permanently leakproof piping systems capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes by use of reducing fittings.
  2. Locate piping runs, except as otherwise indicated, vertically and horizontally; pitch to drain and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, columns and other structural and permanent enclosure elements of building; limit clearance to 1/2 inch where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any.
  3. Provide domestic water connections to equipment requiring them from valved outlets dedicated for this service.
  4. Cap or plug open ended valves for future connections, drains and vents.
  5. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures unless unavoidable. Install drip pan under piping that must be run through electrical spaces.
  6. Pipe Joints - Mechanical
    - a. Make mechanical joints in strict accordance with the recommendation of the manufacturer using jointing material provided with the pipe.
    - b. Clean jointing surfaces thoroughly by wire brushing before assembly. Center spigot in bell, apply soapy water and slip the gasket over the spigot and into the bell.
  7. Arrangement and Alignment
    - a. Install piping in straight parallel lines.
    - b. Install pipe groups for plumbing and HVAC parallel with pipe of other trades.

- c. Space pipe supports, arrange reducers and pitch piping to allow air to be vented to system high points and to allow the system to be drained at the low points. Provide drain valves at the base of each riser, at low points and wherever required to permit complete draining of lines.
  - d. Provide automatic air vents at high points of water lines and wherever required to allow air to vent from system. Each vent shall have a drain line piped to nearest indirect waste.
  - e. Configure piping with loops, swing joints, anchors, base elbows, etc. as required and approved to assure proper expansion and contraction of elements of the piping system without damage to equipment, structure, or piping.
  - f. Provide runouts, risers and connections to coils, convectors and fan-coil units with double swing joint connections to withstand expansion and contraction.
  - g. Pipe and fittings furnished as part of factory fabricated equipment are specified as part of equipment assembly in other sections.
8. Fittings - General
- a. Make changes in size and direction of piping with fittings. Do not use miter fittings, face or flush bushings, close nipples or street elbows.
  - b. Make branch connections with tees as directed by the Engineer.
  - c. Use eccentric reducing fittings or eccentric reducing couplings where required by the contract documents or where required to prevent pocketing of liquid or non-condensable.
  - d. Fittings shall be factory manufactured. Shop or field fabricated fittings are not acceptable.
  - e. A nipple shall be considered any piece of pipe 6 inches in length or less. Threaded nipples shall be extra heavy. Do not use close nipples.
  - f. Screw threads shall be cut clean and true; make screw joints tight without caulking. Caulking is not permitted; a non-hardening lubricant is acceptable. Bushings shall not be used. Make reductions, otherwise causing objectionable water or air pockets, with eccentric reducers or eccentric fittings. Ream out pipe after cutting to remove burrs.
9. Connections to Equipment and Control Valves
- a. Provide flanges or unions at final connections to equipment and control valves to facilitate dismantling. Offset connections to permit removal or servicing of equipment being serviced without dismantling the piping.
  - b. Provide automatic valves with a gate valve and a strainer on the inlet side.
  - c. Install supply piping to coils, pumps and other equipment including gate valves and strainers at line size. Make reductions in size only at the inlet to the control valve or pump. Install the outlet piping from the control valve at the full size of the tapping in the equipment served.
  - d. Install piping and dirt pockets or mud legs in return lines the full size of the tapping in the equipment served. Install piping, check valves and strainers in these return lines beyond the dirt pockets the size of the tapping in the trap.
  - e. Provide "quick-fill" connections from domestic water supply to circulating water systems. Connections shall be 1-1/2 inches minimum and shall have removable spool pieces or backflow devices in accordance with applicable codes.

B. Valves

1. General Requirements

- a. Install valves with handwheels horizontally or vertically upward unless specifically shown otherwise.

- b. Install valves in accessible locations to facilitate easy removal for repair or replacement.
- c. Connect threaded end valves installed in copper tubing lines where joints are ordinarily soldered or brazed to the tubing by means of adapters screwed into the valves and soldered or brazed into the tubing.
- d. Valves shall be full line size, unless otherwise indicated.
- e. Double regulating and check valve discs shall be in accordance with manufacturer's recommendations for the service.
- f. Valves shall be capable of being repackaged while wide open and operating at their rated pressure.
- g. Where angle valves are indicated or required, use equivalent of specified globe type.
- h. Provide 5 operating wrenches for each type of valve not equipped with handwheels.
2. Except as otherwise indicated, install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Locate valves to be accessible and so that separate support can be provided when necessary. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward from horizontal plane unless unavoidable. Install valve drains with hose-end adapter for each valve that must be installed with stem below horizontal plane.
3. Insulation: Where insulation is indicated, install extended-stem valves; arrange in proper manner to receive insulation.
4. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select and install valves with the following ends or types of pipe/tube connections:
  - a. Tube Size 2 Inches and Smaller: Soldered-joint valves.
  - b. Pipe Size 2 Inches and Smaller: One of the following, at Installer's option:
    1. Threaded valves
    2. Grooved-end valves
    3. Butt-welding valves
    4. Socket-welding valves
    5. Flanged valves
  - c. Pipe Size 2-1/2 Inches and Larger: One of the following, at Contractor's option, as approved by Engineer:
    1. Socket-welding valves
    2. Flanged valves
    3. Wafer valves
    4. Mechanical joint end valves
  - d. Valve System: Select and install valves with outside screw and yoke stems, except provide inside screw non-rising stem valves where headroom prevents full opening of valves. However non-rising stem shall not be accepted for fire fighting system.
  - e. Installation of Check Valves
    1. Swing Check Valves: Install in horizontal position with hinge pin horizontally perpendicular to center line of pipe. Install for proper direction of flow.
    2. Wafer Check Valves: Install between 2 flanges in horizontal or vertical position; position for proper direction of flow.
    3. Lift Check Valve: Install in piping line with stem vertically upward; position for proper direction of flow.

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### 3.04 FIELD QUALITY CONTROL

#### A. Material Tests and Identification

1. In addition to the tests required for specific systems, the manufacturer shall test or guarantee material specified prior to delivery.
2. Inspect materials for defects. Identify materials with factory applied permanent stampings or markings designating their conformance with specified requirements.

#### B. Hydrostatic Pressure Tests

1. Test piping including valves, fittings and joints at a pressure equal to at least 1-1/2 times the rated or system pressure, as indicated. Perform the test hydrostatically unless directed otherwise. Minimum pressure shall be as indicated in Section 15110 "Pipe, Fittings and Valves - Application".
2. Blank off or remove elements such as traps, instruments, automatic valves, diaphragm valves, relief valves, pumps or any other equipment which may be damaged by test pressure. Open, but do not back seat, valves.
3. Fill the system with water and vent the system at high points to remove air.
4. Maintain the required test pressure for a sufficient length of time to enable complete inspection of joints and connections but no less than 4 hours.
5. Repair leaks or defects uncovered by the tests and retest the system.
6. After completion of tests, drain the system and blow out and clean it of rust and/or foreign matter. Clean strainers, valves and fittings of dirt, filings and debris.
7. Do not insulate or conceal piping until completion of tests and approval of the results.
8. Perform tests in the presence of, and to the satisfaction of, the Engineer.

#### C. Testing of Piping - General

1. Test piping, mains, and joints for leaks, before any piping is enclosed, insulated, or concealed in any way. Follow specific procedures, if given, in the other specification sections.
2. Refrigerant piping. Test for leaks with a halide torch. Recharge each system as necessary after testing.
3. Provide temporary equipment for testing, including pump and gauges. Test piping system before insulation is installed, wherever feasible, and remove control devices before testing. Test each natural section of each piping system independently, but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time.
  - a. Required minimum test period is 24 hours.
  - b. Test runs at pressures listed except where fittings are lower Class or pressure rating.
  - c. Test each piping system at 150 percent minimum of operating pressure indicated, but not less than 8 bars test pressure.
  - d. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5 percent of test pressure.
4. Repair piping system sections which fail required piping test by disassembly and reinstallation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.
5. Drain test water from piping systems after testing and repair work has been completed.

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### 3.05 CLEANING, FLUSHING, INSPECTING AND DISINFECTION

- A. Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings, if any. Flush out piping systems with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.
- B. Disinfect water mains and water service piping in accordance with AWWA C601.
- C. Cleaning - Piping Systems
1. Plug open ends of piping, valves and equipment except when actual work is being performed, to minimize accumulation of dirt and debris.
  2. After installation is complete, place temporary screens at connections to equipment and at automatic control valves where permanent strainers are not provided.
  3. Prior to the performance of tests, flush out piping that is to receive a hydrostatic test with clean water. Blow out piping that is to be air or gas pressure tested with compressed air.
  4. Remove dirt and debris collected at screens, strainers and other points from the system.
  5. After hydrostatic testing, blow out fuel oil lines with compressed air until dry.
  6. Where noted, flush out fuel oil pipe lines with clean oil after lines are dry.
- D. Supplemental Cleaning - Water
1. After the piping system is installed, tested and flushed, completely clean the system to remove organic, rust and other foreign matter and provide protection of the metal surfaces in preparation for permanent water treatment.
  2. Use a cleansing agent which will not in any way interact with any of the materials in the system to produce corrosion, form deposits, weaken, reduce the life or in any way have a detrimental effect on any system components.
  3. Fill the system with clean water and add sufficient cleaning preparation to provide a concentration adequate to perform complete cleaning. Add the cleaning preparation at a point which will assure good mixing and complete dispersal throughout the system.
  4. Provide temporary receivers or drums to accommodate any foam that may form.
  5. Circulate the mixture of cleanser and water for a sufficient length of time to complete the cleaning.
  6. Drain the system, flush with clean water, clean strainers and screens and refill the system.
- E. Disinfection Water Systems
- Disinfect new water systems prior to use whenever samples from the system show any contamination after making a bacteriological examination. Follow the following method:
1. Flush the pipe system with clean water until no dirty water appears at the outlets.
  2. Fill the system or part thereof with a water-chlorine solution containing at least 50 ppm of chlorine and valve off the system or part thereof and allow to stand for 24 hours or, fill the system or part thereof with a water-chlorine solution containing at least 200 ppm of chlorine and allow to stand for 3 hours.
  3. Following the prescribed standing time, flush the system with clean water until no excess chlorine remains in the water coming from the system.
  4. Repeat the procedure if it is shown that contamination still persists in the system.
- F. Valve Adjustment: After testing and putting piping systems into service, but before final testing, adjusting, and balancing, inspect each valve for possible leaks. Adjust or replace packing to stop leaks; replace valve if leak persists.

- G. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touchup paint.
- H. Gaskets: Gaskets for HVAC system shall be as directed by the Engineer.

END OF SECTION

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## SECTION 15140

### SUPPORTS AND ANCHORS

#### 1 - GENERAL

##### 1.01 SUMMARY

- A. Provide labor, materials, equipment and services, and perform operations required for complete installation of the works related to this section as indicated on the drawings and specified herein.
- B. Work Included: The work shall include, but not be limited to, the following:
1. Extent of supports and anchors required by this section is indicated on drawings and/or specified in other Division 15 sections.
  2. Supports and anchors shall be of approved type.
  3. Supports and anchors furnished as part of factory-fabricated equipment, are specified as part of equipment assembly in other Division 15 sections.
- C. Related Work Specified Elsewhere
1. Section 15010 - Basic Mechanical Requirements.
  2. Section 15050 - Basic Mechanical Materials and Methods.

##### 1.02 QUALITY ASSURANCE

Materials and work shall conform to the latest edition of reference specifications and industry standards listed below and specified herein and to applicable codes and requirements of local authorities having jurisdiction, whichever is more stringent.

Code Compliance: Comply with applicable plumbing codes pertaining to product materials and installation of supports and anchors.

##### 1.03 SUBMITTALS

Submit the following in accordance with the requirements specified under Submittals in Section 15010.

- A. Shop Drawings: Submit shop drawings for work specified herein for approval. Shop drawings shall show manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly or components.
- B. Product Data
1. Submit copies of manufacturer's latest published literature for materials specified herein for approval; obtain approval before ordering materials.
  2. Data shall include manufacturer's technical product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.

1.04 DELIVERY, STORAGE AND HANDLING

Exercise proper care in the handling of work so as not to injure the finished surfaces, and protect the work from damage after it is in place.

2 - PRODUCTS

A. HANGERS AND SUPPORTS FOR STEEL PIPES

The pipe hangers shall be of the individual or trapeze type as conditions require and shall be constructed of structural galvanized steel hangers with rubber gaskets, with adjusting galvanized nuts.

Horizontal pipes shall be supported as the following table and at all changes in direction to ensure that the deflection does not exceed 3mm.

<u>Pipes Diameter</u>	<u>Distance between Supports</u>	<u>Rod Diameter</u>
Till 1"	200 cm	8 mm
From 1" to 2"	250 cm	10 mm
From 2 ½" to 3"	350 cm	10 mm
From 4" to 6"	450 cm	14 mm

Vertical pipes shall be provided with heavy galvanized iron clamps, one at every floor at least.

Pipes shall not be hung from other piping and no wire, tape or metal bends shall be used as substitute for hangers.

Hangers and supports shall be secured to the structure by providing inserts in the concrete, or by means of fish plates in cases of heavy load.

All black steel hangers and supports (used in special cases only) and upon special approval shall be painted with two coats of an approved rust preventive paint. All hangers and supports exposed to view shall have two finishing coats of aluminum paint.

The pipe hangers, spacing and all components used for the fire fighting system, must be as recommended by NFPA.

B. HANGERS AND SUPPORTS FOR COPPER PIPES

The pipe hangers shall be of the individual or trapeze type as conditions require and shall be constructed of structural galvanized steel hanger rods with adjusting galvanized nuts.

Horizontal pipes shall be supported as the following table and at all changes in direction.

<u>Pipes Diameter</u>	<u>Distance between Supports</u>	<u>Rod Diameter</u>
Till ¾"	150 cm	8 mm
From 1" to 1 ¼"	180 cm	8 mm
From 1 ½" to 2"	240 cm	10 mm
From 2 ½" to 3"	280 cm	10 mm

Vertical pipes shall be provided with heavy galvanized iron clamps, one at every floor at least for pipes of 1" and above, and one at 1.2 m for pipes up to ¾".  
Pipes shall not be hung from other piping and no wire, tape or metal bends shall be used as substitute for hangers.

Hangers and supports shall be secured to the structure by providing inserts in the concrete, or by means of fish plates in cases of heavy load.

All black steel hangers and supports (used in special cases only) and upon special approval shall be painted with two coats of an approved rust preventive paint. All hangers and supports exposed to view shall have two finishing coats of aluminum paint.  
Iron supports for copper pipes shall be lined with felt between pipe and support to prevent electrolytic corrosion caused by dissimilar metals.

C. CLAMPS FOR PVC PIPES

PVC pipes shall be supported with galvanized steel clamps with rubber gasket as recommended by the pipes manufacturer.

Anchorage of the PVC pipe work shall be provided by using clamps with an in-laid plastic strip to ensure a firm hold after each group of fittings immediately following the last coupling, and using loose clamps between the fittings.

Horizontal and vertical lines shall be supported as the following table:

<u>Pipes Diameter</u>	<u>Distance between Supports for horizontal Pipes</u>	<u>Distance between Supports for vertical Pipes</u>	<u>Rod Diameter</u>
Till 1"	75 cm	150 cm	8 mm
From 1" to 2"	105 cm	210 cm	10 mm
From 2 ½" to 3"	140 cm	270 cm	10 mm
For 4"	150 cm	300 cm	10 mm
For 6"	180 cm	360 cm	10 mm
For 8" and larger	220 cm	360 cm	10 mm

3 - EXECUTION

3.01 EXAMINATION

Examine conditions at the job site where work of this section is to be performed to insure proper arrangement and fit of the work. Start of work implies acceptance of job site conditions.

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### 3.02 PREPARATION

- A. Examine the Contract Drawings and specifications in order to insure the completeness of the work required under this Section. Provide supplementary parts necessary to complete work, though not specifically indicated on Drawings or specified herein.
- B. Verify measurements and dimensions at the job site and cooperate in the coordination and scheduling of the work of this Section with the work of related trades, so as not to delay job progress.
- C. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.
- D. Prior to installation of hangers, supports, anchors and associated work, Contractor shall meet at project site with installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

### 3.03 INSTALLATION

- A. Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal piping to support together on trapeze type hangers where possible. Install supports as directed by the Engineer. Where supporting piping of various sizes together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
- B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

### 3.04 ADJUSTING AND CLEANING

- A. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.
- B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.
- C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touchup paint.

END OF SECTION

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## SECTION 15155

### DRAINAGE AND VENT PIPING

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Provide labor, materials, equipment and services, and perform operations required for complete installation of the works related to this section as indicated on the drawings and specified herein.
- B. This Section includes sanitary drainage and vent piping, and storm drainage piping inside building and to locations indicated.
- C. Related Sections include the following:
  - 1. Section 15430 - Plumbing Specialties: Plumbing specialties for drainage and vent piping system specialties.

##### 1.2 DEFINITIONS

- A. Sewerage Piping: Building sewer piping outside building that conveys sanitary sewage from building.
- B. Drainage Piping: Building sewer piping outside building that conveys storm drainage from building.
- C. Service Entrance Piping: Drainage piping at entry into building between outside building sewer piping and inside drainage piping.
- D. Drainage and Vent Piping: Piping inside building that conveys waste water and vapors from fixtures and equipment throughout the building.
- E. Force-Main Piping: Drainage piping, under pressure.
- F. The following are industry abbreviations for plastic and other piping materials:
  - 1. ABS: Acrylonitrile-butadiene-styrene.
  - 2. EPDM: Ethylene-propylene-diene polymer, rubber.
  - 3. PVC: Polyvinyl chloride.
  - 4. HDPE: High density polyethylene.

##### 1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
  - 1. PVC Soil, Waste, and Vent Systems: (30 kPa).
  - 2. PVC Storm Drainage Systems: (30 kPa).

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#### 1.4 SUBMITTALS

- A. Test Results and Reports: Specified in "Field Quality Control" Article.

#### 1.5 QUALITY ASSURANCE

- A. Provide listing/approval stamp, label, or other marking on piping made to specified standards.
- B. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
- C. Comply with European Norm for drainage & vent piping.

### 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. PVC pipes:
    - a. Redi.
    - b. Wavin.
    - c. Omniplast.
    - d. Dalmine.

#### 2.2 PIPES AND TUBES

- A. General: Applications of the following pipe and tube materials are indicated in Part 3 "Piping Applications" Article.
- B. PVC Plastic Pipe: EN 1329, EN 1401, or ASTM D 2665, Schedule 40.
- C. PVC Plastic Soundproof Pipe: EN 14366.

#### 2.3 PIPE AND TUBE FITTINGS

- A. General: Applications of the following pipe and tube fitting materials are indicated in Part 3 "Piping Applications" Article.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311 drain, waste, and vent pipe patterns.
- C. PVC Plastic, Tubular Fittings: ASTM F 409 drainage pattern, with ends as required for application.

#### 2.4 JOINING MATERIALS

- A. General: Applications of the following piping joining materials are indicated in Part 3 "Piping Applications" Article.

- B. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for commonly used joining materials.
- C. Flexible, Transition Couplings for Underground, Non-pressure Piping: ASTM C 1173 with elastomeric sleeve. Include ends same sizes as piping to be joined and include corrosion-resistant metal band on each end.
  - 1. Gasket Type for Dissimilar-End Piping: Rubber or elastomeric compression gasket, made to match inside diameter of pipe or hub, and outside diameter of adjoining pipe. Include the following:
    - a. Gaskets for Plastic Piping: ASTM F 477 elastomeric seal.
    - b. Gaskets for Dissimilar Piping: Compatible with piping materials to be joined.
- D. High density polyethylene pipes: electric butt welding where space permits; electro-weld sleeve couplings otherwise; according to the manufacturer's recommendations.
- E. PVC: Rubber ring sealed socket joint.
- F. PVC: Solvent cemented welding.

## 2.5 VALVES

- A. Refer to Division 15 Section "Valves" for general-duty valves. Use valves specified for "Domestic Water Piping" applications.

## 2.6 ACCESSORIES AND ATTACHMENTS

- A. The required accessories, fittings and attachments, etc. for the complete furnishing and installation of each item shall include but not limited to the following:
  - 1. As detailed in the drawings and specified here in.
  - 2. Elbows, tees, etc.
  - 3. Necessary pipe connections between 2 different materials.
  - 4. Supports, hangers, sleeves, etc.
  - 5. Adequate pipe wrapping with bituminous tape for all concealed metallic piping, etc.
- B. The pipes inside toilets, between the plumbing fixtures and the floor drain, to be part of the various plumbing fixtures.

## PART 3 EXECUTION

### 3.1 EXCAVATION

- A. Refer to Division 2 Section "Earthwork" for excavating, trenching, and backfilling.

### 3.2 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated.

- C. Aboveground: Use the following for Soil, Waste, and Vent Piping.
  - 1. (DN32 to DN65): PVC plastic pipe, PVC socket fittings with solvent-cemented joint for pipes inside toilets.
  - 2. (DN100 and above): PVC plastic pipe, PVC socket fittings with rubber joint, for pipes outside toilets.

### 3.3 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Shutoff Duty: Use gate, ball, or butterfly valves.
  - 2. Throttling Duty: Use globe, ball, or butterfly valves.
- B. Grooved-end butterfly valves may be used with grooved-end piping.

### 3.4 PIPING INSTALLATION, GENERAL

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.

### 3.5 SERVICE ENTRANCE PIPING INSTALLATION

- A. Refer to Division 2 Section "Sanitary Sewerage" for sanitary and storm sewer piping.
- B. Extend building sanitary drain piping and connect to sanitary sewer piping in sizes and locations indicated for service entrances into building. Install cleanout and extension to grade at connections of building sanitary drains with building sanitary sewers.
- C. Extend building storm drain piping and connect to storm sewer piping in sizes and locations indicated for service entrances into building. Install cleanout and extension to grade at connections of building storm drains and building storm sewers.
- D. Extend building sanitary drain, force-main piping and connect to sanitary sewer piping in size and location indicated for service entrance into building. Install cleanout, fitting with closure plug or equivalent, inside building.
- E. Extend building storm drain, force-main piping and connect to storm sewer piping in size and location indicated for service entrance into building. Install cleanout, fitting with closure plug or equivalent, inside building.
- F. Install HDPE sleeve with water stop and mechanical sleeve seal at each service entrance pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for sleeves and mechanical sleeve seals.
- G. Install wall penetration system at each service entrance pipe penetration through foundation wall. Make installation watertight. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for wall penetration systems.

### 3.6 DRAINAGE AND VENT PIPING INSTALLATION

- A. Make changes in direction for 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 2 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 make change in direction of flow greater than 90 degrees. Use proper size of standard increasers and reducers if different sizes of piping are connected. Reducing size of drainage piping in direction of flow is prohibited.
- B. Lay buried building drain 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.
- C. Install drainage and vent piping at the following minimum slopes, unless otherwise indicated:
  - 1. Sanitary Building Drain: 2 percent downward in direction of flow for piping (DN80) and smaller; 1 percent downward in direction of flow for piping (DN100) and larger.
  - 2. Horizontal, Sanitary Drainage Piping: 2 percent downward in direction of flow.
  - 3. Storm Building Drain: 1 percent downward in direction of flow.
  - 4. Horizontal, Storm Drainage Piping: 2 percent downward in direction of flow.
  - 5. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- D. Install force mains at elevations indicated.
- E. Install PVC plastic drainage piping according to ASTM A888 or CISPI301.
- F. Install all required cleanouts and vent lines whether shown or not on the drawings.
- G. Install cleanouts at intervals of 30 meters maximum.
- H. Install vent connections to sewage piping within 150 mm of the trap.

### 3.7 JOINT CONSTRUCTION

- A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Grooved Joints: Assemble joints with coupling, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- C. Handling of Solvent Cements, Primers, and Cleaners: Comply with procedures in ASTM F 402 for safe handling during joining of plastic pipe and fittings.
- D. PVC Piping Joints: Join drainage piping according to ASTM D 2665.

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### 3.8 VALVE INSTALLATION

- A. Shutoff Valves: Install shutoff valve on each pump discharge and where indicated. Use gate or ball valves for piping (DN50) and smaller. Use gate or butterfly valves for piping (DN65) and larger.
- B. Check Valves: Install swing check valve on each pump discharge, downstream from shutoff valve.

### 3.9 HANGER AND SUPPORT INSTALLATION

- A. Refer to Division 15 Section "Hangers and Supports" for pipe hanger and support devices. Install the following:
  - 1. Riser clamps, MSS Type 8 or Type 42, for vertical runs.
  - 2. Adjustable steel clevis hangers, MSS Type 1, for individual, straight, horizontal runs (30 m) and less.
  - 3. Adjustable roller hangers, MSS Type 43, for individual, straight, horizontal runs longer than (30 m).
  - 4. Spring cushion rolls, MSS Type 49, if indicated, for individual, straight, horizontal runs longer than (30 m).
  - 5. Pipe rolls, MSS Type 44, for multiple, straight, horizontal runs (30 m) or longer. Support pipe rolls on trapeze.
  - 6. Spring hangers, MSS Type 52, for supporting base of vertical runs.
- B. Install supports according to Division 15 Section "Hangers and Supports."
- 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 (10 mm) minimum rods.
- E. Install hangers for PVC plastic piping with the following maximum spacing and minimum rod diameters:
  - 1. (DN40 and DN50): Maximum horizontal spacing, (1200 mm) with (10 mm) minimum rod diameter; maximum vertical spacing, (1200 mm).
  - 2. (DN100 and DN125): Maximum horizontal spacing, (1200 mm) with (16 mm) minimum rod diameter; maximum vertical spacing, (1200 mm).
  - 3. (DN150): Maximum horizontal spacing, (1200 mm) with (19 mm) minimum rod diameter; maximum vertical spacing, (1200 mm).
  - 4. (DN200 through DN300): Maximum horizontal spacing, (1200 mm) with (22 mm) minimum rod diameter; maximum vertical spacing, (1200 mm).
- F. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.10 CONNECTIONS

- A. Connect service entrance piping to exterior sewerage and drainage piping. Use transition fitting to join dissimilar piping materials.

- B. Connect drainage piping to service entrance piping, and extend to and connect to the following:
  - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Fixtures."
  - 2. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Specialties."
  - 3. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections (DN65) and larger.

### 3.11 FIELD QUALITY CONTROL

- A. Inspect drainage and vent piping as follows:
  - 1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
  - 2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
    - a. Roughing-In Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
  - 3. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedure, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
  - 3. Roughing-In Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than (30 kPa). Water level must not drop from 15 minutes before inspection starts through completion of inspection. Inspect joints for leaks.
  - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of (250 Pa). Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
  - 5. Repair leaks and defects using new materials and retest piping or portion thereof until satisfactory results are obtained.
  - 6. Prepare reports for tests and required corrective action.

- C. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedure, as follows:
  - 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.
  - 2. Cap and subject piping to static-water pressure of (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
  - 3. Repair leaks and defects using new materials and retest piping or portion thereof until satisfactory results are obtained.
  - 4. Prepare reports for tests and required corrective action.

### 3.12 CLEANING AND PROTECTING

- A. Clean interior of piping system. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of water-based latex paint.

END OF SECTION 15155

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## SECTION 15310

### FIRE FIGHTING

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Provide labor, materials, equipment and services, and perform operations required for complete installation of fire fighting system and related work as indicated on the drawings and specified herein.
- B. Work Included: The work shall include, but not be limited to, the following:
  - 1. Fire extinguisher.

##### 1.02 QUALITY ASSURANCE

Materials and work shall conform to the latest edition of industry standards, reference specifications specified herein and to applicable codes and requirements of local authorities having jurisdiction, whichever is more stringent.

##### 1.03 SUBMITTALS

Submit the following in accordance with the requirements specified under Submittals in Section 15010.

- A. Product Data: Submit copies of manufacturer's latest published literature for materials specified herein for approval, and obtain approval before ordering materials.
- B. Shop Drawings: Submit shop drawings for work specified herein for approval.
- C. Maintenance Data: Submit maintenance data and spare parts lists for each type of manufactured piping specialty. Include this data, product data, and shop drawings in maintenance manual in accordance with requirements of Section 15010.

##### 1.04 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials and handle so as to prevent the inclusion of foreign materials and the damage of materials.
- B. Store materials and equipment where designated. Assume responsibility and security for materials and equipment and protect from detrimental conditions.

## PART 2 PRODUCTS

### 2.01 PORTABLE FIRE EXTINGUISHER

Supply and install all portable fire extinguishers wherever shown on the drawings and as specified herein.

1. Carbon dioxide "CO<sub>2</sub>" of 5 kg capacity.
2. Dry chemical "ABC" type of 6 kg capacity.
3. All brass operating valve, large size operating lever, full vision pressure gauge and discharge hose.

## PART 3 EXECUTION

### 3.01 EXAMINATION

Examine conditions at the job site where work of this section is to be performed to insure proper arrangement and fit of the work. Start of work implies acceptance of job site conditions.

### 3.02 PREPARATION

- A. Examine the Contract Drawings and specifications in order to insure the completeness of the work required under this Section.
- B. Verify measurements and dimensions at the job site and cooperate in the coordination and scheduling of the work of this Section with the work of related trades, so as not to delay job progress.

END OF SECTION

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## SECTION 15430

### PLUMBING SPECIALTIES

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Provide labor, materials, equipment and services, and perform operations required for complete installation of the works related to this section as indicated on the drawings and specified herein.
- B. This Section includes plumbing specialties for the following:
  - 1. Water distribution systems.
  - 2. Soil, waste, and vent systems.
  - 3. Storm drainage systems.
- C. Related Sections include the following:
  - 1. Division 15 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, basic installation requirements, and escutcheons, dielectric fittings, sleeves, and sleeve seals that are not in this Section.
  - 2. Division 15 Section "Valves" for general-duty ball, butterfly, check, gate, and globe valves.
  - 3. Division 15 Section "Meters and Gages" for thermometers, pressure gages, fittings, and water meters.
  - 4. Division 15 Section "Mechanical Identification" for labeling and identifying requirements.
  - 5. Division 15 Section "Domestic Water Piping" for water-supply piping and connections.
  - 6. Division 15 Section "Drainage and Vent Piping" for drainage and vent piping and connections.

##### 1.2 SYSTEM PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with the minimum working-pressure ratings, specified in section 15155.

##### 1.3 SUBMITTALS

- A. Product Data: For each plumbing specialty indicated. Include rated capacities of selected equipment and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections for the following plumbing specialty products:
  - 1. Backflow preventers.
  - 2. Water regulators.
  - 3. Strainers.
  - 4. Drain valves.
- B. Reports: Specified in "Field Quality Control" Article.

- 
- C. Maintenance Data: For specialties to include in the maintenance manuals specified in Division 1. Include the following:
1. Backflow preventers.
  2. Water regulators.

#### 1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, dimensional requirements, and characteristics of plumbing specialties and are based on the specific types and models indicated. Other manufacturers' products with equal performance characteristics may be considered.
- B. Provide listing/approval stamp, label, or other marking on plumbing specialties made to specified standards.
- C. Listing and Labeling: Provide electrically operated plumbing specialties specified in this Section that are listed and labeled.
1. Terms "Listed" and "Labeled": As defined in National Electrical Code, Article 100.
- D. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
- E. Comply with NFPA 70, "National Electrical Code," for electrical components.
- F. Comply with European Norm for components and installation,

#### 1.5 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
1. Operating Key Handles: Furnish one extra key for each key-operated hose bibb and hydrant installed.

### 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. Backflow Preventers, water regulators, water hammer arresters:
    - a. FLOMATIC Corp.
    - b. Grinnell Corp.; Mueller Co. Marketing Group for Hersey Products Div.
    - c. IMI Cash Valve.
    - d. Watts Industries, Inc.; Water Products Div.
    - e. Zurn Industries, Inc.; Wilkins Div.
    - f. Honeywell Braukman.
    - g. Josam.

2. Drainage Equipments:
  - a. ACO
  - b. Nicoll.
  - c. Zurn.
  - d. Geberit.
  - e. Pont-A-Mousson.
  - f. Frankiche

## 2.2 BACKFLOW PREVENTERS

- A. General: ASSE standard, backflow preventers, of size indicated for maximum flow rate and maximum pressure loss indicated.
  1. (DN50) and Smaller: Bronze body with threaded ends.
  2. (DN65) and Larger: Bronze, cast-iron, steel, or stainless steel body with flanged ends.
    - a. Interior Lining: AWWA C550 or FDA-approved, epoxy coating for backflow preventers having cast-iron or steel body.
  3. Interior Components: Corrosion-resistant materials.
  4. Exterior Finish: Polished chrome-plate if used in chrome-plated piping system.
  5. Strainer on inlet, if indicated.
- B. Double-Check Detector Assembly Backflow Preventers: ASSE 1048, FM approved or UL listed, and suitable for continuous pressure application. Include outside screw and yoke gate valves on inlet and outlet, and strainer on inlet. Include test cocks; 2 positive-seating check valves; and bypass with displacement-type water meter, valves, and double-check backflow preventer.
  1. Pressure Loss: (35 kPa) maximum, through middle one-third of flow range.
- C. Hose-Connection Backflow Preventers: ASSE 1052, suitable for at least (0.19 l/s) flow and applications with up to (600 kPa) back pressure. Include 2 check valves; intermediate atmospheric vent; and nonremovable, ASME B1.20.7 garden-hose thread on outlet.

## 2.3 PRESSURE WATER REGULATORS TYPE 1

- A. General: ASSE 1003, water regulators, rated for required initial working pressure, of size, flow rate, and inlet and outlet pressures indicated. Include integral factory-installed Y-pattern strainer and strainer on the outlet side.
  1. (DN50) and Smaller: Bronze body with threaded ends.
  2. (DN65) and Larger: Bronze or cast-iron body with flanged ends. Include AWWA C550 or FDA-approved interior epoxy coating for regulators with cast-iron body.
  3. Interior Components: Corrosion-resistant materials.
- B. Unit to be of the silent type and equipped with two manometers.

## 2.4 PILOT OPERATED PRESSURE WATER REGULATOR TYPE 2

- A. 20 bar minimum rating, housing, cover plate, cone and diaphragm plate to be cast iron, pressure spring and control rod to be stainless steel; pressure-regulating type.
- B. The pressure regulator shall comprise the following:
  1. Housing with high pressure flanges to DIN 2533.

2. Two throttle valves,
3. Pilot valve.
4. Ball valves on inlet and outlet connections of control pipe.
5. Venting valve.
6. Two manometers.

C. Unit to be of the silent type. Regulator must not generate any noise at extra low flow.

## 2.5 STRAINERS

- A. Strainers: Y-pattern, unless otherwise indicated, and full size of connecting piping. Include ASTM A 666, Type 304, stainless-steel screens with (1.2 mm) round perforations, unless otherwise indicated.
1. Pressure Rating: (860 kPa) minimum steam working pressure, unless otherwise indicated.
  2. (DN50) and Smaller: Bronze body, with female threaded ends.
  3. (DN65) and Larger: Cast-iron body, with interior AWWA C550 or FDA-approved epoxy coating and flanged ends.
  4. Y-Pattern Strainers: Screwed screen retainer with centered blowdown.
    - a. Drain: Pipe plug.
    - b. Drain: Factory- or field-installed, hose-end drain valve.
  5. Basket Strainers: Bolted flange or clamp cover, and basket with lift-out handle.
    - a. Simplex Type: Single unit, with one basket.
    - b. Duplex Type: Double unit, with bronze or stainless steel diverter valve and 2 baskets.
    - c. Drain: Pipe plug.
    - d. Drain: Factory- or field-installed, hose-end drain valve.

## 2.6 DRAIN VALVES

- A. Hose-End Drain Valves: MSS SP-110, (DN20) ball valve, rated for (2760 kPa) minimum CWP. Include 2-piece, ASTM B 62 bronze body with standard port, chrome-plated brass ball, replaceable seats and seals, blowout-proof stem, and vinyl-covered steel handle.
1. Inlet: Threaded or solder joint.
  2. Outlet: Short-threaded nipple with ASME B1.20.7 garden-hose thread and cap.
  3. Hose-End Drain Valve Option: MSS SP-80, gate valve, Class 125, ASTM B 62 body, with (DN20) threaded or solder-joint inlet and ASME B1.20.7 garden-hose threads on outlet and cap. Hose bibbs are prohibited for this application.
  4. Fire-Hose-End Drain Valve Option: UL 668, (DN40), bronze body, 90-degree angle or straightway-pattern hose valve, rated for (1200 kPa) minimum working pressure.
    - a. Male Outlet Threads: NFPA 1963 and local fire department standards. Include attached chain and cap.
      - 1) Option: (DN65) valves with (DN65 by DN40) adapter and attached chain and cap may be provided instead of (DN40) valves.
- B. Stop-and-Waste Drain Valves: MSS SP-110, ball valve, rated for (1380 kPa) minimum CWP or MSS SP-80, Class 125, gate valve; ASTM B 62 bronze body, with (DN6) side drain outlet and cap.

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## 2.7 DRAINAGE EQUIPMENT

- A. PVC floor drains with trap:
1. These floor drains shall be for installations executed under the floor tiles. They shall be of PVC with multiple waste inlet connections.
  2. Cover plate and frame shall be of bronze chrome plated subject to Architect approval.
- B. Inspection cleanouts:
1. Inspection cleanouts for connection of floor drain and W.C to the main pipe made with double cross sanitary "T". They shall be of PVC with two 4" inlet connections and one 4" outlet connection.
  2. Cover plate and frame shall be bronze chrome plated subject to Architect approval. The cover shall be locked to the frame to ensure an airtight closure.
- C. Floor cleanouts:
1. The cleanouts shall be of the same material and dimensions as the pipes to be cleaned and shall be placed under the floor slabs or extended through to terminate flush with the finished floor.
  2. Floor cleanouts with covers shall be formed with a "Y", "F" or 45° elbow fitting of the same material and size as the pipe accommodated and provided with an adapter and a threaded brass plug.
  3. Cover plate and frame shall be bronze chrome plated subject to Architect approval. The cover shall be locked to the frame to ensure an airtight closure.
- D. In line cleanouts:
1. In line cleanouts shall be installed in all change in direction of even if not shown on the drawings.
  2. The cleanout shall be of the same material and dimensions as the pipe to be cleaned and shall be terminated with a screwed cap.
- E. Roof drains:
1. Rain water drainage from the roof shall be ensured by means of PVC roof drains with Horizontal or vertical discharge.
  2. Each drain shall comprise a spherically shaped ball grate screwed to the body. The drain unit body shall be of conical shape with screwed joint and equipped with a double flange for clamping the waterproofing material.
- F. Parking drain:
1. Parking drain shall be installed in parking for the drainage of stormwater and shall be made of cast iron.
  2. Each drain shall be formed of a fixed body with a square top drain, a vertical or horizontal outlet and a removable grille.
- G. Vent caps:
1. Vent caps shall be of PVC material and of a minimum size equal to the size of the corresponding pipe
- H. Concrete channels (trench):
1. Rain water concrete channel with ductile iron grating and frame.

I. Manhole

1. Manhole Construction

- a. Concrete works shall be of 40 MPa, and to be designed as specified in Division 3.
- b. Manholes shall be constructed of concrete as shown on the drawings.  
The base (where required) shall be of pre-cast reinforced concrete.  
The shaft shall be constructed of poured reinforced concrete to suit the required depth.  
The top shall be of reinforced concrete. An opening suitable for the cover shall be left in the top around which the radial concrete bricks or concrete ring are built for proper adjustment of levels. Bricks shall be fully bedded in mortar and the inside surface of joints finished flush and clean.
- c. The benching for sewage manholes shall be formed in the bottom of manholes in concrete. "U" channels shall be formed with bottom flush with inside surfaces of pipes and sides extending the full height of the largest pipe and then sloped back at a minimum fall of 10%. The benching and channels shall be finished with 2 cm thick rendering composed of 1/2 cement/sand mortar, and surface hardened with two coats of sodium silicate solution brushed on. The finished diameter of channels shall be the same as the diameter of pipes entering or leaving the manhole.
- d. The paint for the manhole interior shall be coal tar epoxy resin.
- e. The depth of manholes are variable, the dimensions are according to the depth.

<u>Depth</u>	<u>Dimensions</u>
Less than 40 cm	40 x 40 cm
From 40 cm to 120 cm	60 x 60 cm
From 120 cm to 180 cm	100 x 100 cm
More than 180 cm	120 x 120 cm

- f. The dimensions of manholes shown on the drawings and/or BOQ are for cover only. Required dimension of manhole to be as specified here in.

2. Covers and Frames

- a. Covers and frames shall be ductile iron, heavy duty and having the sizes shown on the drawings. They shall be according to EN 124 class A 15 for the areas which can only be used by pedestrians and pedal cyclists, class B 125 for the car parks or car parking decks and class D 400 for all types of road vehicles.
- b. They shall be with double seal for soil and waste water manholes.
- c. The frames shall be embedded in cement mortar and the covers shall be properly sealed in grease all round.
- d. The covers and frames shall be painted inside and outside with coal tar containing not less than 25% epoxy.
- e. Covers for rain water manhole in garden: Cover and frame for rain water manhole in garden shall be ductile iron class C250.
- f. Covers for rain water and sewage manhole: Cover to be ductile iron circular shape, clear opening 60 cm, class B125 non-ventilated with polyethylene ring for air tightness.
- g. Covers for rain water manhole with grille: Cover to be square grating 60 x 60 cm ductile iron class 125.

## 2.8 MISCELLANEOUS PIPING SPECIALTIES

- A. Irrigation faucet (Hose Bibbs): Bronze body, with renewable composition disc, (DN15 or DN20) threaded or solder-joint inlet. Provide ASME B1.20.7 garden-hose threads on outlet and integral or field-installed, nonremovable, drainable, hose-connection vacuum breaker.
  - 1. Finish: Chrome or nickel plated.
  - 2. Operation: Wheel handle.
- B. Roof Flashing Assemblies: Manufactured assembly made of (20 kg/sq. m), (1.6 mm ) thick, lead flashing collar and skirt extending at least (200 mm) from pipe with galvanized steel boot reinforcement, and counter-flashing fitting.
  - 1. Vent Cap: Extended model with field-installed, vandal-proof vent cap.
- C. Stack Flashing Fittings: Counter-flashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
- D. Vent Caps: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.
- E. Expansion Joints: ASME A112.21.2M, assembly with cast-iron body with bronze sleeve, packing gland, and packing, of size and end types corresponding to connected piping.

## 2.9 SLEEVE PENETRATION SYSTEMS

- A. Description: UL 1479, through-penetration firestop assembly consisting of sleeve and stack fitting with firestopping plug.
  - 1. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
  - 2. Stack Fitting: ASTM A 48, cast-iron, hubless-pattern, wye-branch stack fitting with neoprene O-ring at base and cast-iron plug in thermal-release harness in branch. Include PVC protective cap for plug.
    - a. Special Coating: Include corrosion-resistant interior coating on fittings for plastic chemical waste and vent stacks.

## 2.10 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
  - 1. General Use: (20 kg/sq. m or 1.6 mm thickness).
  - 2. Vent Pipe Flashing: (15 kg/sq. m or 1.2 mm thickness).
  - 3. Burning: (30 kg/sq. m or 2.4 mm thickness).
- B. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

## 2.11 ACCESSORIES AND ATTACHMENTS

- A. The required accessories, fittings and attachments, etc. for the complete furnishing and installation of each item shall include but not limited to the following:
  - 1. As detailed in the drawings and specified here in.

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## PART 3 EXECUTION

### 3.1 PLUMBING SPECIALTY INSTALLATION

- A. General: Install plumbing specialty components, connections, and devices according to manufacturer's written instructions.
- B. Install backflow preventers of type, size, and capacity indicated, at each water-supply connection to mechanical equipment and systems, and to other equipment and water systems as indicated. Comply with authorities having jurisdiction. Locate backflow preventers in same room as connected equipment. Install air-gap fitting on units with atmospheric-vent connection and pipe relief outlet drain to nearest floor drain. Do not install bypass around backflow preventer.
- C. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.
- D. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve, and where indicated.
- E. Install hose bibbs with integral or field-installed vacuum breaker.
- F. Install cleanouts in aboveground piping and building drain piping as indicated, and where not indicated, according to the following:
  - 1. Size same as drainage piping up to (DN100). Use (DN100) 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 (15 m) for piping (DN100) and smaller and (30 m) for larger piping.
  - 4. Locate at base of each vertical soil and waste stack.
- G. Install individual stop valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve is not indicated.
- H. Install water-supply stop valves in accessible locations.
- I. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- J. Locate drainage piping as close as possible to bottom of floor slab supporting fixtures and drains.
- K. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

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### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:
  - 1. Install piping connections between plumbing specialties and piping specified in other Division 15 Sections.
  - 2. Install piping connections indicated between appliances and equipment specified in other Sections; connect directly to plumbing piping systems.
  - 3. Install piping connections indicated as indirect wastes from appliances and equipment specified in other Sections, to spill over receptors connected to plumbing piping systems.
- B. Arrange for electric-power connections to plumbing specialties and devices that require power. Electric power is specified in Division 16 Sections.
- C. Supply Runouts to Plumbing Specialties: Install hot- and cold-water-supply piping of sizes indicated, but not smaller than required by authorities having jurisdiction.
- D. Drainage Runouts to Plumbing Specialties: Install drainage and vent piping, with approved trap, of sizes indicated, but not smaller than required by authorities having jurisdiction.
- E. Ground electric-powered plumbing specialties.
  - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- F. Arrange for electric-power connections to plumbing specialties and devices that require power. Electric power, wiring and disconnect switches are specified in Division 16 Sections.

### 3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of factory-authorized service representative to supervise the field assembly of components and installation of grease recovery units, including piping and electrical connections, and to report results in writing.
  - 1. Test and adjust plumbing specialty controls and safeties. Replace damaged and malfunctioning controls and components.

### 3.4 COMMISSIONING

- A. Before startup, perform the following checks:
  - 1. System tests are complete.
  - 2. Damaged and defective specialties and accessories have been replaced or repaired.
  - 3. Clear space is provided for servicing specialties.
- B. Before operating systems, perform the following steps:
  - 1. Close drain valves.
  - 2. Open general-duty valves to fully open position.
  - 3. Remove and clean strainers.
  - 4. Verify drainage and vent piping are clear of obstructions. Flush with water until clear.

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- C. Startup Procedures: Follow manufacturer's written instructions. If no procedures are prescribed by manufacturer, proceed as follows:
    - 1. Energize circuits for electrically operated units. Start and run units through complete sequence of operations.
  - D. Adjust operation and correct deficiencies discovered during commissioning.

### 3.5 DEMONSTRATION

- A. Startup Services: Engage a factory-authorized service representative to perform startup services and train Owner's maintenance personnel as specified below:
  - 1. Train Owner's maintenance personnel on procedures and schedules related to startup of and servicing interceptors.
  - 2. Train Owner's maintenance personnel on procedures and schedules related to startup of and servicing grease recovery units.
  - 3. Review data in the maintenance manuals. Refer to Division 1 Section "Closeout Procedures."
  - 4. Review data in the maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
  - 5. Schedule training with Owner with at least 7 days' advance notice.

### 3.6 PROTECTION

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

END OF SECTION 15430

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## SECTION 15441

### DOMESTIC WATER PUMPS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Provide labor, materials, equipment and services, and perform operations required for complete installation of the works related to this section as indicated on the drawings and specified herein.
- B. This Section includes the following types of water distribution pumps for plumbing systems:
  - 1. In-line circulators.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Section 15100 - Valves.
  - 2. Section 15444 - Packaged Booster Pumps.
  - 3. Division 16 - Electrical: Power-supply wiring, field-installed disconnects, required electrical devices, and motor controllers.

##### 1.2 PUMP PERFORMANCE REQUIREMENTS

- A. Pump Pressure Ratings: At least equal to system maximum operating pressure at point where installed.

##### 1.3 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data including certified performance curves, weights (shipping, installed, and operating), furnished specialties, and accessories. Include startup instructions.
- C. Shop drawings showing layout and connections for pumps. Include setting drawings with templates, directions for installation of foundation and anchor bolts, and other anchorages.
- D. Wiring diagrams detailing wiring for power, signal, and control systems differentiating between manufacturer-installed wiring and field-installed wiring.
- E. Product certificates signed by pump manufacturers certifying accuracies under specified operating conditions and compliance with specified requirements.
- F. Maintenance data for each type and size pump specified to include in the "Operating and Maintenance Manual" specified in Division 1 Section "Closeout Procedures."

##### 1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with provisions of the following:
  - 1. ASME B31.9 "Building Services Piping" for piping materials and installation.

2. H.I. "Hydraulic Institute Standards for Centrifugal, Rotary and Reciprocating Pumps" for pump design, manufacture, and installation.
  3. UL 778 "Standard for Motor Operated Water Pumps" for construction requirements. Include UL listing and labeling.
  4. NEMA MG 1 "Standard for Motors and Generators" for electric motors. Include NEMA listing and labeling.
  5. NFPA 70 "National Electrical Code" for electrical components and installation.
  6. EN European Norm for components and installation.
- B. Single-Source Responsibility: Obtain same type of pumps from a single manufacturer.
- C. Design Criteria: Drawings indicate sizes, profiles, connections, and dimensional requirements of pumps and are based on specific manufacturer types and models indicated. Pumps having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions and profiles do not change the design concept or intended performance as judged by the Architect. The burden of proof for equality of pumps is on the proposer.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store pumps in a clean, dry location.
- B. Retain shipping flange protective covers and protective coatings during storage.
- C. Protect bearings and couplings against damage from sand, grit, or other foreign matter.
- D. Comply with pump manufacturer's rigging instructions for handling.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
1. Armstrong Pumps, Inc.
  2. Bell & Gossett Div., ITT Fluid Technology Corp.
  3. Grundfos Pumps Corp.
  4. Peerless pump.
  5. Taco, Inc.
  6. Lowara.

#### 2.2 PUMPS, GENERAL

- A. Description: Factory-assembled and-tested, single-stage, centrifugal pump units, complying with, suitable for potable and domestic water service; with all bronze or stainless steel construction and components in contact with water made of corrosion resistant materials.
- B. Motors: Comply with requirements in Division 15 Section "Motors" with built-in thermal overload protection appropriate for motor size and duty.

- C. End connections for (DN50) and smaller: Threaded Pumps available only with flanged ends may-be furnished with threaded companion flanges.
- D. End Connections for (DN65) and Larger: Flanged.
- E. Finish: Manufacturer's standard paint applied to factory-assembled and -tested plumbing pump units before shipping.
- F. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

### 2.3 END-SUCTION PUMP

- A. General Description: Centrifugal, close coupled, end suction, single-stage, all bronze, radially split case design, rated for the working pressure of the served system and (107 deg C) continuous water temperature. Include back pull-out design, except where other design is indicated.
- B. Casing: Bronze, with flanged piping connections, and threaded gage tapings at inlet and outlet flange connections.
- C. Impeller: ASTM B 584 cast bronze, statically and dynamically balanced, closed, overhung, single suction, keyed to shaft, and secured by a locking cap screw.
- D. Wearing Rings: Replaceable bronze casing ring.
- E. Pump Shaft and Sleeve Bearings: Steel shaft with bronze sleeve. Include flinger on motor shaft between motor and seals to prevent liquid that leaks past pump seals from entering the motor bearings.
- F. Mechanical Seals: Carbon steel rotating ring, stainless steel spring, ceramic seat, and flexible bellows and gasket.
- G. Motor: Directly mounted to pump casing with supporting legs as an integral part of motor enclosure.

### 2.4 GENERAL-DUTY VALVES

- A. Refer to Section 15100 for general-duty gate, ball, butterfly, globe, and check valves.

### 2.5 ACCESSORIES AND ATTACHMENTS

- A. The required accessories, fittings and attachments, etc. for the complete furnishing and installation of each item shall include but not limited to the following:
  - 1. As detailed in the drawings and specified here in.
  - 2. Gate valve and strainer on the suction pipe of each pump.
  - 3. Silent check valve on the discharge pipe of each pump.
  - 4. Flexible connections.
  - 5. Pressure gauges.
  - 6. Supports, vibration isolators, etc.
  - 7. Float switches in the tanks.

8. Factory made control panel including pumps automatic alternator, relays, contractors, pilot lights, wires, cables, etc.
9. Necessary pressure tank of the adequate size.
10. Necessary programmable timer for the circulators.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, equipment foundations, and conditions with Installer present for compliance with requirements for installation and other conditions affecting performance of plumbing pumps. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine roughing-in of plumbing piping systems to verify actual locations of piping connections prior to pump installation.

### 3.2 CONCRETE

- A. Install concrete bases of dimensions indicated for base-mounted pumps. Refer to Division 3 Section "Cast-in-Place Concrete" and Section 15050.

### 3.3 INSTALLATION

- A. Install pumps according to the manufacturer's written installation instructions.
- B. Install pumps in locations indicated and arrange to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.
- C. Support pumps and piping so that weight of piping is not supported by pumps.
- D. Suspend horizontal, in-line pumps independent from piping. Use continuous-thread hanger rods and vibration isolation hangers of sufficient size to support weight of pumps. Fabricate brackets or supports as required for pumps.
- E. Suspend vertical, in-line pumps independent from piping. Use continuous-thread hanger rods and vibration isolation hangers of sufficient size to support weight of pumps.
- F. End-Suction Pumps: Install on concrete bases.

### 3.4 CONNECTIONS

- A. Connect piping to pumps as indicated. Install valves that are same size as piping connecting to pumps.
- B. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- C. Install shutoff valve and strainer on suction side of in-line pumps and circulators.
- D. Install shutoff valve and strainer on suction side of end-suction pumps.
- E. Install check and double regulating valves on discharge side of in-line pumps and circulators

- F. Install check valve and double regulating valve on discharge side of end-suction pumps.
- G. Install flexible pipe connectors on suction and discharge of end-suction pumps. Install flexible pipe connectors upstream from pump suction diffusers and strainers, and between pump casings and discharge valves.
- H. Install pressure gages on suction and discharge of each pump. Install at integral pressure gage tapings where provided.
- I. Install electrical connections for power, controls, and devices.
- J. Electrical power and control wiring and connections are specified in Division 16 Sections.

### 3.5 FIELD QUALITY CONTROL

- A. Check suction piping connections for tightness to avoid drawing air into pumps.
- B. Clean strainers on pump suction piping.
- C. Pump Controls: Set pump controls for automatic start, stop, and alarm operation.

### 3.6 COMMISSIONING

- A. Final Checks Before Startup: Perform the following preventive maintenance operations and checks before startup:
  - 1. Lubricate oil-lubricated-type bearings.
  - 2. Remove grease-lubricated bearing covers and flush bearings with kerosene and thoroughly clean. Fill with new lubricant according to manufacturer's recommendations.
  - 3. Disconnect couplings and check motors for proper rotation. Rotation shall match direction of rotation marked on pump casing.
  - 4. Check that pumps are free to rotate by hand. Pumps for handling hot liquids shall be free to rotate with pump hot and cold. Do not operate pump if bound or if it drags even slightly until cause of trouble is determined and corrected.
  - 5. Check that pump controls are correct for required application.
- B. Starting procedure for pumps with shutoff power not exceeding safe motor power:
  - 1. Prime pumps by opening suction valves and closing drains, and prepare pumps for operation.
  - 2. Open circulating line valves if pumps should not be operated against dead shutoff.
  - 3. Start motors.
  - 4. Open discharge valves slowly.
  - 5. Check general mechanical operation of pumps and motors.
  - 6. Close circulating piping valves once there is sufficient flow through pumps to prevent overheating.
- C. When pumps are to be started against closed check valves with discharge gate valves open, steps are same except open discharge gate valves some time before motors are started.

END OF SECTION 15441

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## SECTION 15444

### PACKAGED BOOSTER PUMPS

#### PART 1 GENERAL

##### 1.1 SUMMARY

- A. Provide labor, materials, equipment and services, and perform operations required for complete installation of the works related to this section as indicated on the drawings and specified herein.
- B. This Section includes packaged booster pumps to maintain pressure in the plumbing and fire systems.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Division 16 - Electrical: Power-supply wiring, field-installed disconnects, required electrical devices, and motor controllers.

##### 1.2 PUMP PERFORMANCE REQUIREMENTS

- A. Pump Pressure Ratings: At least equal to system maximum operating pressure at point where installed.

##### 1.3 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product data including certified performance curves, weights (shipping, installed, and operating), furnished specialties, and accessories. Include startup instructions.
- C. Shop drawings showing layout and connections for pumps. Include setting drawings with templates, directions for installation of foundation and anchor bolts, and other anchorages.
- D. Wiring diagrams detailing wiring for power, signal, and control systems differentiating between manufacturer-installed wiring and field-installed wiring.
- E. Product certificates signed by pump manufacturers certifying accuracies under specified operating conditions and compliance with specified requirements.
- F. Maintenance data for each type and size pump specified to include in the "Operating and Maintenance Manual" specified in Division 1 Section "Closeout Procedures."

##### 1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with provisions of the following:
  - 1. ASME B31.9 "Building Services Piping" for piping materials and installation.
  - 2. H.I. "Hydraulic Institute Standards for Centrifugal, Rotary and Reciprocating Pumps" for pump design, manufacture, and installation.

3. UL 778 "Standard for Motor Operated Water Pumps" for construction requirements. Include UL listing and labeling.
  4. NEMA MG 1 "Standard for Motors and Generators" for electric motors. Include NEMA listing and labeling.
  5. NFPA 70 "National Electrical Code" for electrical components and installation.
  6. EN "European Norm" for components and installation.
- B. Single-Source Responsibility: Obtain same type of pumps from a single manufacturer.
- C. Design Criteria: Drawings indicate sizes, profiles, connections, and dimensional requirements of pumps and are based on specific manufacturer types and models indicated. Pumps having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions and profiles do not change the design concept or intended performance as judged by the Architect. The burden of proof for equality of pumps is on the proposer.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store pumps in a clean, dry location.
- B. Retain shipping flange protective covers and protective coatings during storage.
- C. Protect bearings and couplings against damage from sand, grit, or other foreign matter.
- D. Comply with pump manufacturer's rigging instructions for handling.

### PART 2 PRODUCTS

#### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
1. Armstrong Pumps, Inc.
  2. Bell & Gossett Div., ITT Fluid Technology Corp.
  3. Grundfos Pumps Corp.
  4. KSB.
  5. Peerless pump.
  6. Lowara.

#### 2.2 PACKAGED BOOSTER PUMPS, GENERAL

- A. Description: Factory assembled and-tested, packaged booster pump units, suitable for water service.
- B. Motors: Comply with requirements in Division 15 Section "Motors".
- C. Piping: Comply with requirements in Division 15 Section "Domestic Water Piping".
- D. Piping Option: Piping, including valves and other components, may have grooved ends for grooved joints.

- E. Shutoff Valves, check Valves and strainers: Comply with requirements in Division 15 Sections "Valves" and "Domestic Water Piping".
- F. Sensors: Pressure switches.
- G. Control Panel: Automatic, with load control and protection functions. Comply with NEMA ICS 2 and UL 508.
  - 1. Mounting and Wiring: Factory installed and connected as an integral part of unit.
  - 2. Enclosure: NEMA ICS 6, Type 12.
  - 3. Motor Controller: Full-voltage, combination-magnetic type with undervoltage release feature, motor-circuit-protector-type disconnect, and short-circuit protective device.
    - a. Control Voltage: 120 V ac, using integral control power transformer.
  - 4. Motor Overload Protection: Overload relay in each phase.
  - 5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
  - 6. Duplex, Automatic Alternating Starter: Switches lead pump to lag main pump and to two-pump operation.
  - 7. Triplex, Sequence (Lead-Lag-Lag) Starter: Switches lead pump to one lag main pump and to three-pump operation.
  - 8. Instrumentation: Unit suction and discharge pressure gages.
  - 9. Alarm Signal Device: Sounds alarm when backup pumps are operating
  - 10. Instrumentation: Unit suction and discharge pressure gages.
- H. Finish: Manufacturer's standard paint applied to factory-assembled and tested units before shipping.
- I. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembling and testing. Protect flanges, pipe openings, and nozzles.

### 2.3 VARIABLE-SPEED-DRIVE, PACKAGED BOOSTER. PUMPS

- A. Description: Multiplex packaged unit, with pumps, piping valves, sensors, controls, and adjustable-speed-drive units for variable-speed operation.
  - 1. Pressure Rating: as required to suit system pressure.
  - 2. Pump Arrangement: Duplex, with two equal-size pumps.
  - 3. Pump Arrangement: Triplex, with three equal-size pumps, or as shown on the schedule.
  - 4. Pumps: Comply with "Vertical Pumps," for multistage centrifugal pumps.
    - a. Construction: Multistage, radially split, bronze fitted.
    - b. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, closed, overhung, single suction, and keyed to shaft.
  - 5. Variable-speed-Drive Controllers: Adjustable-speed-drive unit, with master control for each pump.
  - 6. For hydropneumatic tanks refer to Section "Potable-Water Storage Tanks".
  - 7. VFD to have power feedback to the control system BMS (if applicable).

### 2.4 GENERAL-DUTY VALVES

- A. Refer to Section 15100 for general-duty gate, ball, butterfly, globe, and check valves.

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## 2.5 ACCESSORIES AND ATTACHMENTS

- A. The required accessories, fittings and attachments, etc. for the complete furnishing and installation of each item shall include but not limited to the following:
  - 1. As detailed in the drawings and specified here in.
  - 2. Gate valve and strainer on the suction pipe of each pump.
  - 3. Double regulating valve and silent check valve on the discharge pipe of each pump.
  - 4. Flexible connections.
  - 5. Pressure gauges.
  - 6. Supports, vibration isolators, etc.
  - 7. Float switches in the tanks.
  - 8. Factory made control panel including pumps automatic alternator, relays, contractors, pilot lights, wires, cables, etc.
  - 9. Necessary pressure tank of the adequate size.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, equipment foundations, and conditions with Installer present for compliance with requirements for installation and other conditions affecting performance of plumbing pumps. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine roughing-in of plumbing piping systems to verify actual locations of piping connections prior to pump installation.

### 3.2 CONCRETE

- A. Install concrete bases of dimensions indicated for base-mounted pumps. Refer to Division 3 Section "Cast-in-Place Concrete" and Division 15 Section "Basic Mechanical Materials and Methods."

### 3.3 INSTALLATION

- A. Install pumps according to the manufacturer's written installation instructions.
- B. Install pumps in locations indicated and arrange to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.
- C. Support pumps and piping so that weight of piping is not supported by pumps.
- D. Support packaged booster pumps using the following vibration-control devices, unless otherwise indicated. Refer to Division 15 Section "Mechanical Vibration Controls and Seismic Restraints".
  - 1. Install units with total of 7.5 hp or less with rubber-isolator mount or spring-isolator vibration isolators.

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### 3.4 CONNECTIONS

- A. Connect piping to pumps as indicated. Install valves that are same size as piping connecting to pumps.
- B. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
- C. Install shutoff valve and strainer on suction side of each pump.
- D. Install check valve and double regulating valve on discharge side of each pump.
- E. Install flexible pipe connectors on suction and discharge of pumps.
- F. Install pressure gages on suction and discharge of each pump. Install at integral pressure gage tappings where provided.
- G. Install pressure gage connector plugs in suction and discharge piping around pumps.
- H. Install electrical connections for power, controls, and devices.
- I. Electrical power and control wiring and connections are specified in Division 16 Sections.

### 3.5 FIELD QUALITY CONTROL

- A. Check suction piping connections for tightness to avoid drawing air into pumps.
- B. Clean strainers on pump suction piping.
- C. Pump Controls: Set pump controls for automatic start, stop, and alarm operation.

### 3.6 COMMISSIONING

- A. Final Checks Before Startup: Perform the following preventive maintenance operations and checks before startup:
  - 1. Lubricate oil-lubricated-type bearings.
  - 2. Remove grease-lubricated bearing covers and flush bearings with kerosene and thoroughly clean. Fill with new lubricant according to manufacturer's recommendations.
  - 3. Disconnect couplings and check motors for proper rotation. Rotation shall match direction of rotation marked on pump casing.
  - 4. Check that pumps are free to rotate by hand. Pumps for handling hot liquids shall be free to rotate with pump hot and cold. Do not operate pump if bound or if it drags even slightly until cause of trouble is determined and corrected.
  - 5. Check that pump controls are correct for required application.
- B. Starting procedure for pumps with shutoff power not exceeding safe motor power:
  - 1. Prime pumps by opening suction valves and closing drains, and prepare pumps for operation.
  - 2. Open valves if pumps should not be operated against dead shutoff.
  - 3. Start motors.
  - 4. Open discharge valves slowly.

5. Check general mechanical operation of pumps and motors.
6. Close valves once there is sufficient flow through pumps to prevent overheating.

END OF SECTION 15444

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## SECTION 15660

### SPLIT UNITS

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Provide labor, materials, equipment and services, and perform operations required for complete installation of the split units and related work as indicated on the drawings and specified herein.
- B. Work Included: The work shall include, but not be limited to, the following:
  - 1. Extent of split units work required by this section is indicated on drawings and schedules, and by requirements of this section. Types of split units specified in this section include the following:
    - a. Condensing units.
    - b. Evaporator Blower.
    - c. Control and cables.
    - d. Refrigerant pipes
  - 2. Provide factory-mounted and wired controls and electrical devices as specified in this section.

##### 1.02 QUALITY ASSURANCE

Materials shall conform to the latest edition of industry standards and reference specifications specified herein and to applicable codes and requirements of local authorities having jurisdiction, whichever is more stringent.

ASHRAE Compliance: Construct refrigerating system of split heating and cooling units in accordance with ASHRAE Standard 15 "Safety Code for Mechanical Refrigeration."

##### 1.03 SUBMITTALS

Submit the following accordance with requirements specified under Submittals in Section 15010.

- A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights, furnished specialties and accessories and installation and startup instructions.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances and methods of assembly of components.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to split units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring required for final installation of split units and

controls. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

- D. Maintenance Data: Submit maintenance data and parts list for each packaged heating and cooling unit, control and accessory, including "troubleshooting" maintenance guide. Include this data and product data in maintenance manual in accordance with requirements of Section 15010.

#### 1.04 DELIVERY, STORAGE AND HANDLING

- A. Handle split units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged packaged heating and cooling units or components; replace with new.
- B. Store split units and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris and physical damage.
- C. Comply with manufacturer's rigging and installation instructions for unloading split units, and moving units to final locations for installation.

#### 1.05 WARRANTY

Warranty on Motor/Compressor: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, motors/compressors with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly or failure to perform as required. Manufacturer's instructions for handling, installing, protecting and maintaining units must be adhered to during warranty period. Replacement includes component replacement and labor for removal, reinstallation and retesting and balancing.

- A. Warranty Period: one year from Date of Substantial Completion.
- B. Contractor shall include separate service Contract for Labor, if required.

### PART 2 PRODUCTS

#### 2.01 GENERAL

Furnish and install split system air conditioning unit consisting of outdoor unit and matching evaporator blower. Each unit shall provide the total cooling capacity shown on the drawings. Units to be ARI certified for capacity rating.

The listed capacities of A/C units are the net required nominal capacities.

The contractor must submit calculation notes taking into consideration the pipe length, units denivelation, weather condition, etc. for obtaining the required capacities.

#### 2.02 CONDENSING UNIT

- A. Cabinet  
Cabinet shall be of sheet metal zinc coated galvanized steel finished with a weather resistant paint.

- B. Condenser coil  
Condenser coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes arranged in multiple rows, flat or "v" type.
- C. Compressor  
Compressor shall be of the hermetic type equipped with overheat and overload protection. Protection to be of the automatic reset type. The compressor shall be isolated from the cabinet floor by rubber vibration isolators.
- D. Condenser fan and motor  
Condenser fan to be with up or horizontal flow discharge, direct driven, propeller type, statically and dynamically balanced. Fan motor to be of the permanently lubricated type with thermal and current overload protection.
- E. Controls  
Compressor control shall include but not limited to the following:
- High pressure cutout.
  - Low pressure cutout.
  - Time delay on restart to eliminate short cycling.
  - Contactor for compressor.
  - Contactor for condenser fan.
  - Disconnecting switch.

Control shall be factory pre-wired designed for 24 Volts operation.

Three phase compressors shall be also equipped with field installed phase failure and phase inversion detector.

- F. Refrigerant Circuit:  
The condensing unit suction and liquid refrigerant lines shall terminate with shut off valves for units larger or equal to 5 Tons and with quick connect type connections for smaller units.

Circuits shall be field equipped with a filter dryer and sight glass.

### 2.03 EVAPORATOR BLOWER

- A. Casing:  
1. Decorative High Wall Type Unit:  
Casing shall be all plastic with adjustable supply grille, installed horizontally below the return grille.

- B. Coil  
Evaporator shall be constructed of aluminum fins mechanically bonded to seamless copper tubes arranged in multiple rows.

Coil shall be provided with drain pan to catch condensate from coil, fabricated of heavy gauge galvanized steel, and insulated with a minimum of 1/4" layer of insulating mastic. Drain shall be pitched of 1/4" toward the drain hole.

C. Fan and Motor

Fan shall include one or more aluminum centrifugal type fan, forward curved, directly driven by a two-bearing motor, equipped with built-in thermal overload protection.

Motors shall be quiet running and shall have sleeve bearings factory lubricated for life. Motor windings and electrical components shall be impregnated or protected to avoid trouble from condensation.

D. Air filters

Air filters shall have a minimum efficiency of 60% when tested in accordance with B.S. 2831 using Test Dust No 3.

Filter shall be of the permanent, cleanable type and shall be in accordance with the requirements of this subdivision of the Specification. Filters shall be easily removable for cleaning.

2.04 REFRIGERANT PIPES

Refrigerant pipes shall be of seamless copper tube type "L" cleaned of grease and completely closed.

These pipes shall be jointed by silver brazing, using 45% silver brazing alloy and insulated with foam tube.

A trap shall be provided to prevent liquid return to compressor.

Size of refrigerant lines between condensing unit and evaporator blower shall be as recommended by the manufacturer and shall be submitted to the Engineer for approval.

2.05 CABLES

Electric power shall be supplied by the electrical contractor to the evaporator and to the condensing unit. Mechanical contractor to supply only control cables between condensing unit, evaporator and thermostat.

Cables shall be as specified in division 16 with the required number of conductors.

PART 3 EXECUTION

3.01 EXAMINATION

Examine Conditions at the job site where work of this section is to be performed to insure proper arrangement and fit of the work. Start of work implies acceptance of job site conditions.

3.02 PREPARATION

1. Examine the Contract Drawings and specifications in order to insure the completeness of the work required under this Section. Provide supplementary parts necessary to complete all insulation work, though not specifically indicated or specified herein.
2. Verify all measurements and dimensions at the job site and cooperate in the coordination and scheduling of the work of this section with the work of related trades, so as not to delay job progress.

### 3.03 INSTALLATION

1. Install split units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchor in locations indicated and maintain manufacturer's recommended clearances.
2. Electrical Wiring
  - a. Turn over to Electrical Contractor devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Contractor.
  - b. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division 16 sections. Do not proceed with equipment startup until wiring installation is acceptable to equipment manufacturer.
3. Drain Piping - Connect unit drain to nearest indirect waste connection. Provide trap at drain pan, construct at least 1 inch deeper than fan pressure in inches of water.

### 3.04 FIELD QUALITY CONTROL

Startup split units, in accordance with manufacturer's startup instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment

### 3.05 DEMONSTRATION

1. Provide services of manufacturer's technical representative for one-half day to instruct Employer's personnel in operation and maintenance of split units.
  - a. Schedule training with Employer, provide at least 7-day notice to Contractor and Engineer of training date.
  - b. Provide operating and maintenance manuals as approved.

END OF SECTION

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## SECTION 15865

### FANS

#### PART 1 GENERAL

##### 1.01 SUMMARY

- A. Provide labor, materials, equipment and services, and perform operations required for complete installation of the fans and related work as indicated on the drawings and specified herein.
- B. Work Included: The work shall include, but not be limited to fans

##### 1.02 QUALITY ASSURANCE

Materials shall conform to the latest edition of industry standards and reference specifications specified herein and to applicable codes and requirements of local authorities having jurisdiction, whichever is more stringent.

##### 1.03 SUBMITTALS

Submit the following accordance with requirements specified under Submittals in Section 15010.

1. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights, furnished specialties and accessories and installation and startup instructions.
2. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances and methods of assembly of components.

##### 1.04 DELIVERY, STORAGE AND HANDLING

- A. Handle fans and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged fans or components; replace with new.
- B. Store fans and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris and physical damage.

#### PART 2 PRODUCTS

##### 2.01 TOILETS EXHAUST FANS

Wall extract fans shall be of totally enclosed design and shall be provided with means to close the air outlet when the fan is "OFF" and to open the outlet when the fan starts.

Wall mounted extract fans shall be provided with flush fitting exterior grilles and they shall be provided with interior panels to conceal the fan. All fans shall be selected for quiet operation.

### PART 3 EXECUTION

#### 3.01 EXAMINATION

Examine Conditions at the job site where work of this section is to be performed to insure proper arrangement and fit of the work. Start of work implies acceptance of job site conditions.

#### 3.02 PREPARATION

1. Examine the Contract Drawings and specifications in order to insure the completeness of the work required under this Section. Provide supplementary parts necessary to complete all fan installation, though not specifically indicated or specified herein.
2. Verify all measurements and dimensions at the job site and cooperate in the coordination and scheduling of the work of this section with the work of related trades, so as not to delay job progress.

#### 3.03 INSTALLATION

Install fans in accordance with manufacturer's installation instructions.

#### 3.04 FIELD QUALITY CONTROL

Startup fans in accordance with manufacturer's startup instructions.

END OF SECTION