



KEY PLAN

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United Nation Development Programme
UNDP Lebanon
Social and Local Development Programme
P.O. Box: 11-3216 Beirut, Lebanon
Tel: 961 1 962491

PROGRAMME: Lebanese Host Communities Support Programme
Support to Integrated Service Provision at the Local Level

PROJECT NAME:

MHAMARA MUNICIPALITY

NOTES:

- 01-ALL DIMENSIONS ARE IN MILLIMETER UNLESS OTHERWISE INDICATED.
- 02-THOSE DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL OTHER TRADES FOR COORDINATION PURPOSES AND IN CONJUNCTION WITH THE SPECIFICATIONS.
- 03-THE CONTRACTOR SHALL VERIFY THE PLUMBING LAYOUT AND EXECUTE IN ACCORDANCE WITH THE APPROVED SHOP DRAWINGS.
- 04-ALL FLOOR CLEANOUTS ARE 110MM UNLESS OTHERWISE INDICATED.
- 05-ALL FLOOR DRAINS ARE WITH 50MM INLETS AND 75MM OUTLET.
- 06-LOCATION OF ALL FLOOR DRAINS AND FLOOR CLEAN OUTS SHALL BE READ IN CONJUNCTION WITH ARCHITECTURAL TILING LAYOUTS.
- 07-ALL SANITARY PPES INSTALLED ARE UNPLASTICISED POLYVINYL CHLORIDE.
- 08-WF NEED 20 cm CLEAR OF FILING IN WC FOR DRAIN PIPS AND 15 cm IN KITCHEN

1	HAJ	17/02/2017	FOLLOWING COMMENTS
0	HAJ	24/01/2017	FIRST ISSUE
REV	BY	Date	Description
PROJECT NBR.	---		

PROJECT PHASE TENDER
DISCIPLINE MECHANICAL ENGINEERING

SECTOR	
BUILDING	MH
DESIGNED	MH
DRAWN	MH
CHECKED	HAJ
APPROVED	HAJ
DATE	17/02/2017
SCALE	NTS
SHEET SIZE	A1

MHAMARA MUNICIPALITY
DRAINAGE DESIGN LAYOUT

S1601KR-PH1-SW-01-REV.1

Sheet 1 OF 1	Project Number	Phase	Type	Drawing Number	Revision
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DRAINAGE LEGEND		
ABBREVIATIONS	DESIGNATION	SYMBOLS
VP	VENT PIPE	VP
SP	SOIL PIPE	SP
WP	WASTE PIPE	WP
FCO	FLOOR CLEAN OUT	FCO
FD	FLOOR DRAIN	FD
LAV	LAVATORY	LAV
WC	WATER CLOSET	WC
KS	KITCHEN SINK	KS
T/B	TO BELOW	T/B
T/A	TO ABOVE	T/A
ACL	ABOVE CEILING LEVEL	ACL
THL	TO HIGH LEVEL	THL
UT	UNDER TILES	UT
IW	INSIDE WALL	IW

SCHEDULE FOR DRAINAGE FIXTURE OUTLETS	
DESCRIPTION	Ømm
LAVATORY	50
WC	110
KITCHEN SINK	50

UPVC FLOOR CLEAN-OUT DETAIL – END OF LINE (90° INCLINED)

Ø	4" (110 mm)
c	175 mm

WATER CLOSET DETAILS

LAVATORY & KITCHEN SINK DETAILS



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- 03-THE CONTRACTOR SHALL VERIFY ADEQUATE SPACES. COORDINATE WITH OTHER DRAWINGS AND EXECUTE IN ACCORDANCE WITH THE APPROVED SHOP DRAWING.
- 04-ALL PIPES IN FALSE CEILING ARE GALVANIZED STEEL WHILE PIPES RUNNING UNDER TILES OR EMBEDDED IN WALLS ARE POLYPROPYLENE.
- 05-THE DISTANCE BETWEEN THE COLD, HOT WATER PIPES RUNNING SHALL BE MIN. 100MM.
- 06-ALL THREADED END VALVES SHALL BE INSTALLED WITH UNIONS.
- 07-ALL DOWN FEED PIPES SHALL BE INSTALLED WITH AUTOMATIC AIR VENT.
- 08-ISOLATION ANGLE VALVES ARE TO BE INSTALLED UNDER ALL THE LAVATORIES AND SINK.

1	HAJ	17/02/2017	FOLLOWING COMMENTS
0	HAJ	24/01/2017	FIRST ISSUE
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PROJECT NBR.	---		

PROJECT PHASE
DISCIPLINE MECHANICAL ENGINEERING
SECTOR

BUILDING
DESIGNED MH
DRAWN MH
CHECKED HAJ
APPROVED HAJ

DATE 17/02/2017
SCALE NTS
SHEET SIZE A1

Title
MHAMARA MUNICIPALITY
WATER SUPPLY DESIGN LAYOUT

Sheet 1 OF 1

S1601KR-PH1-SW-01-REV.1

Project Number | Phase | Type | Drawing Number | Revision

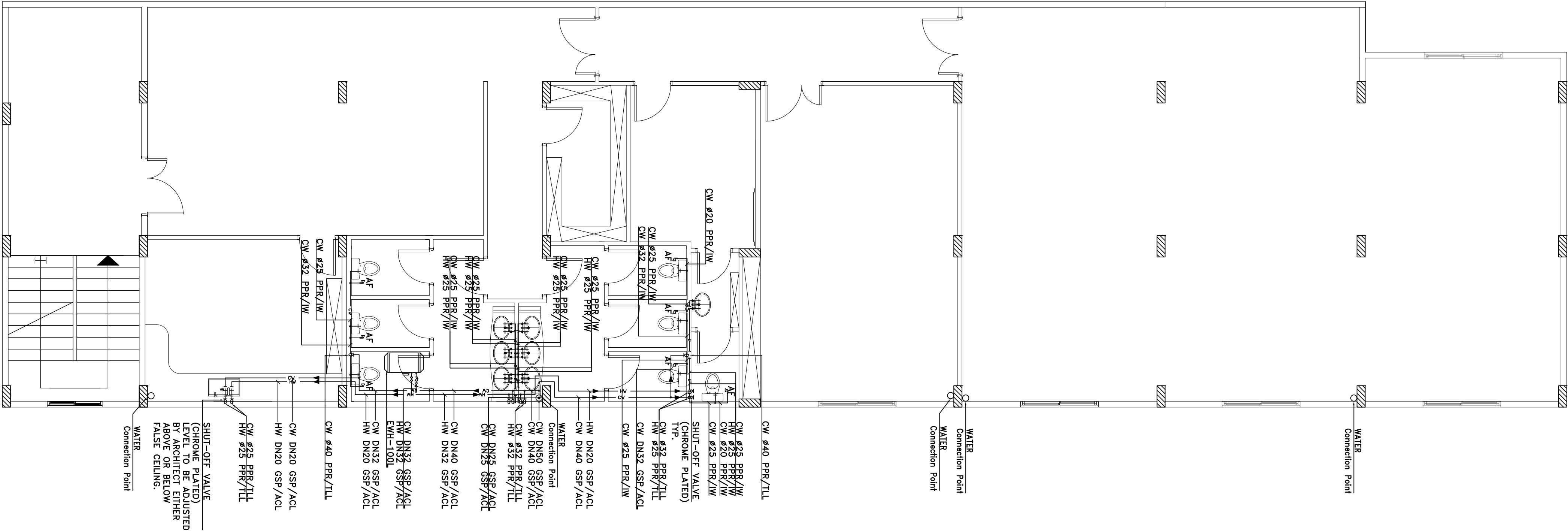
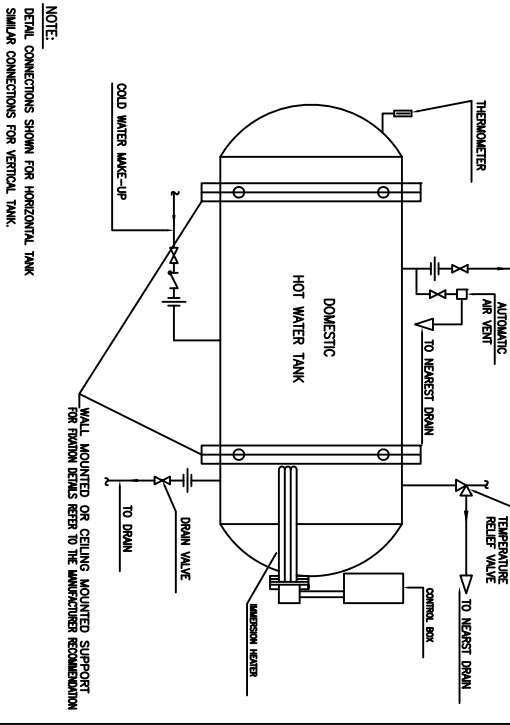
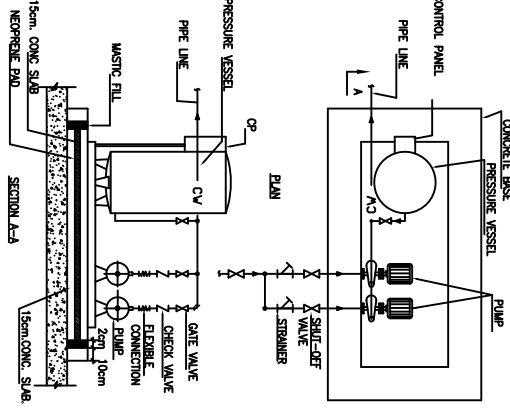
WATER SUPPLY LEGEND		
ABBREVIATIONS	DESIGNATION	SYMBOLS
CW	COLD WATER PIPE	— CW —
SP	HOT WATER PIPE	— HW —
LAV	LAVATORY	
WC	WATER CLOSET	
KS	KITCHEN SINK	
EMH	ELECTRIC WATER HEATER	
GV	GATE VALVE	
CV	CHECK VALVE	
AF	SHUT OFF VALVE RECESSED IN WALL ABLUTION FAUCET	
ACL	ABOVE CEILING LEVEL	
TLL	TO LOW LEVEL	
IW	INSIDE WALL	

SCHEDULE FOR WATER DISTRIBUTION FIXTURE OUTLETS				
DESCRIPTION	COLD WATER Ømm (PPR)	HOT WATER Ømm (PPR)		
LAVATORY	25	25		
WC (FLUSH TANK)	25	—		
ABLUTION FAUCET	20	—		
KITCHEN SINK	25	25		

SCHEDULE OF ELECTRIC WATER HEATER				
Designation	Service	Type	Capacity	Electric heater /cylinder
EMH	HOT WATER FOR TOILETS & KITCHEN	HORIZONTAL	100 L	Qty Kw Volts/Ph/Hz
			1	1.5 220/1/50

SCHEDULE OF BOOSTER PUMP SET					
Designation	LOCATION	Type	FLOW*	HEAD*	Qty Kw Volts/Ph/Hz
BP	ROOF	BOOSTER SET 2	L/S 2	BAR 1	1.1 220/1/50

NB: – HEADS TO BE RECALCULATED BY THE CONTRACTOR ACCORDING TO THE FINAL SYSTEM PRESSURE DROP
– THE SELECTION OF THE PUMPS SHALL BE MADE AT BEST EFFICIENCY CURVE WITHIN THE RANGE OF PUMP TYPE
– UNIT SHALL BE COMPLETED WITH CONTROL CHECK VALVES & FITTINGS.



BOOSTER SCHEMATIC DIAGRAM

DOMESTIC ELECTRIC WATER HEATER CONNECTIONS



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PROJECT NAME:
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NOTES:

Title

1	H/AJ	17/02/2017	FOLLOWING COMMENTS	
0	H/AJ	24/01/2017	FIRST ISSUE	---
REV	BY	Date	Description	Appr.
PROJECT NBR. ---				
DISCIPLINE MECHANICAL ENGINEERING				
SECTOR				
DESIGNED MH				
DRAWN MH				
CHECKED H/AJ				
APPROVED H/AJ				
DATE 17/02/2017				
SCALE NTS				
SHEET SIZE A1				

MHAMARA MUNICIPALITY
HVAC DESIGN LAYOUT

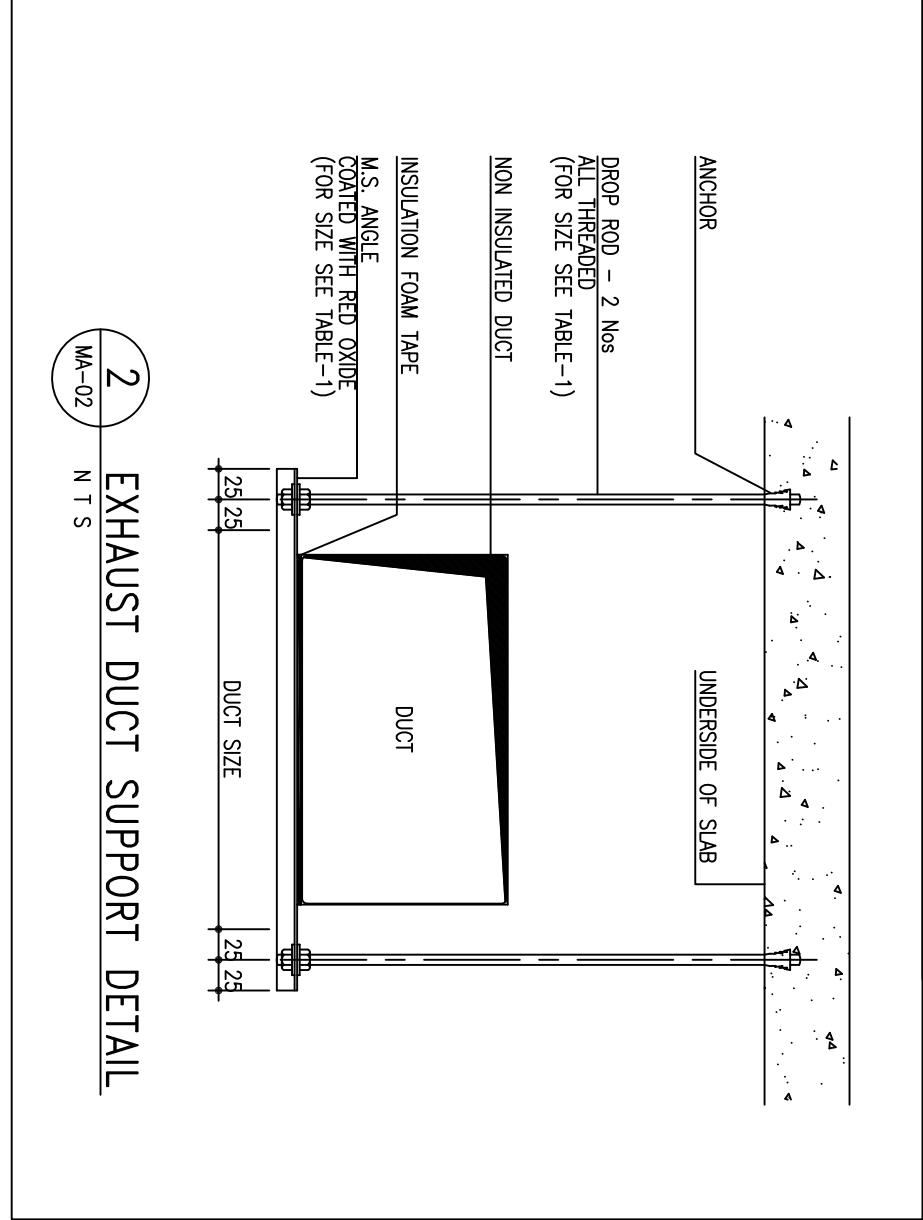
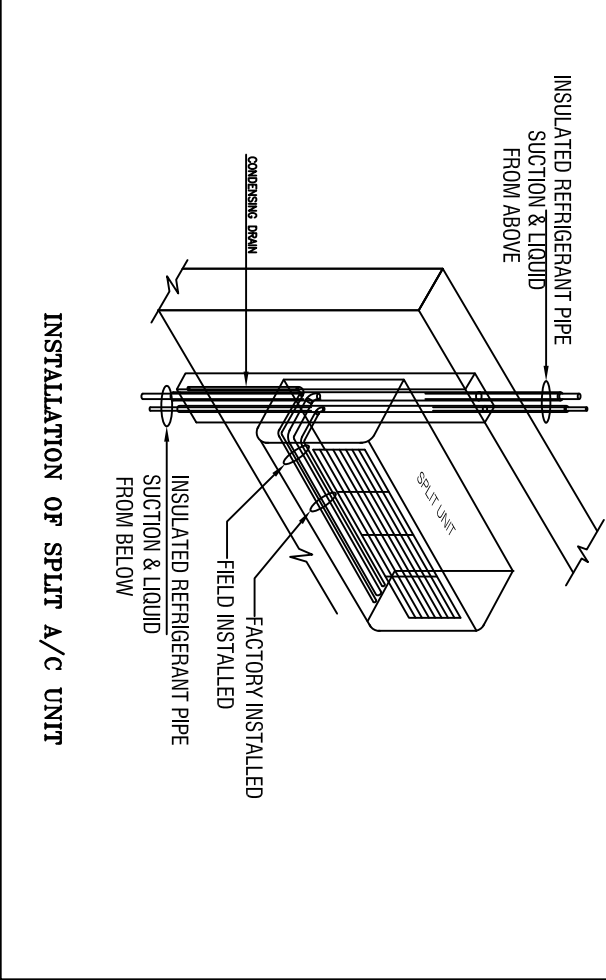
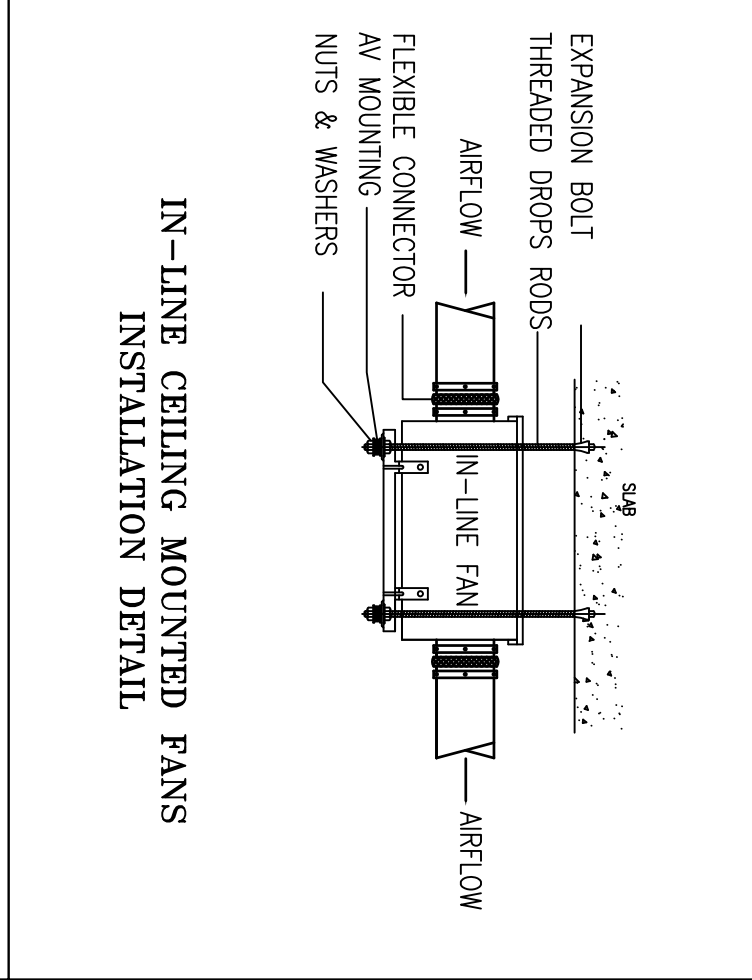
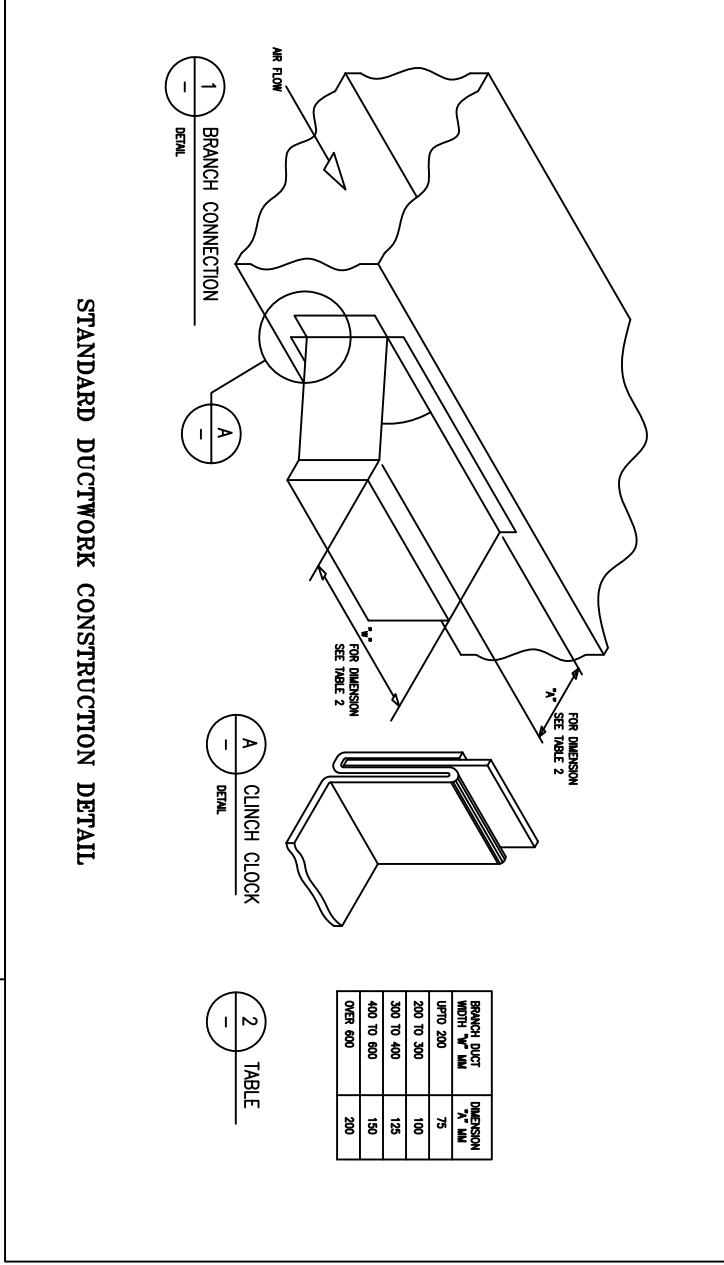
S1601KR-PH1-SW-01-REV.1

Sheet 1 OF 1

Project Number Phase Type Drawing Number Revision

Schedule for the air conditioning machines					
TAG	Space served	AC Type	Cooling Capacity BtU/H	Air Flow L/S	Condensate outlet Drain pipe mm
IU-1	KITCHEN	WALL	18 000	-	25
IU-2	OFFICE	WALL	12 000	-	25
IU-3	MEETING ROOM	WALL	24 000	-	25
IU-4	RECEPTION	WALL	24 000	-	25
IU-5	TRAINING HALL	WALL	36 000	-	25
IU-6	TRAINING HALL	WALL	36 000	-	25
IU-7	TRAINING HALL	WALL	36 000	-	25

TAG	LOCATION	SERVED AREA	QUANTITY	AIR FLOW (L/S)	PHASE VOLTAGE (V*PH*Hz) POWER W	TYPE	REMARKS
EXF-WC-1	TOILET	TOILET	1	225	220V/150 600W	Centrifugal inline	LOW HEIGHT AND LOW NOISE TYPE OPERATED BY A TIMER



DIVISION 15
MECHANICAL SPECIFICATION

SECTION 15110 - VALVES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes general duty valves common to several mechanical piping systems.
- B. N.B: Grooved system is not mandatory piping joint.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 15 Testing Adjusting and Balancing section
 - 2. Division 15 Section Water Distribution piping.
 - 3. Division 15 Section Hydronic piping.
 - 4. Valve tags and charts are specified in Division 15 Section "Mechanical Identification."

1.2 SUBMITTALS

- A. Product Data for each valve type. Include all components material, standard compliance, dimensions, required clearances, and installation instructions. Include list indicating valve and its application.
- B. Shop drawings in two alternatives showing the exact installation of the main shut off valves for the Bathrooms and toilets : one alternative showing the embedded wall type and the detail of the false ceiling and location, of the valves hidden .
- C. Balancing valves: Submit balancing data and selected balancing valves Kv values based on calculations done for the hydronic system (refer to submittals requirements of Hydronic Piping section).
- D. Maintenance data for valves to include in the operation and maintenance manual.

1.3 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
- B. ISO Compliance: Comply with ISO 9001 and ISO 9002 for the Quality management systems of the manufacturer.
- C. Manufacturer representative should approve the compliance sheet in the submittals and should approve the installation during erection and during commissioning of the valves.

PART 2 -

PART 3 - PRODUCT

3.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane
 - b. Hattersley
 - c. TA
 - d. GRINELL
 - e. VICTAULIC

3.2 BASIC, COMMON FEATURES

- A. Design: Non rising stem.
- B. Sizes: Same size as upstream pipe, unless otherwise indicated. Balancing valves or control valves sizing to follow system balancing requirements
- C. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- D. Threads: to BS21 (ISO 7)
- E. Flanges: to BS 4504.
- F. Grooved-end: to pipe grooving standard.

DIVISION 15
MECHANICAL SPECIFICATION

3.3 GATE VALVES

- A. Bronze Gate Valve
1. Application: Isolation of water and distribution mains up to and including DN50.
 2. Type: Solid wedge, Nonrising stem screwed-in bonnet, threaded to BS 21 or grooved and manufactured to BS 5154 PN 16 for series B rating.
 3. Material:
 - a. Body Bronze to BS 2872 CZ122
 - b. Stem : brass, A metal or bronze
 - c. Union bonnet ring: cast bronze
 - d. Gland: Machined from brass bar
 - e. Packing nut : machined from brass bar.
 - f. Hand wheel : Die cast Aluminum
 - g. Disk : Brass to BS 2872 CZ 122
- B. Cast Iron Gate Valve
1. Application: Isolation of water distribution mains for larger than DN 50.
 2. Type: Wedge disk, Nonrising stem, inside screw, comply to BS 5150, PN 16 Flanged to BS 4504.
 3. Material:
 - a. Disk: cast Iron with Bronze facing
 - b. Disknut: Bronze
 - c. Body seat rings: Bronze
 - d. Stem : Brass
 - e. Gaskets : Asbestos free
 - f. Bolting : Carbon steel to BS 4190
 - g. Handwheel : Maleable iron handwheel

3.4 BALL VALVES

- A. Application : Shut-off and and flow control up to DN 80.
- B. Type: Two-pieces, Quarter turn, lever operation or lockshield, Threaded to BS 21 or grooved.
- C. Material:
1. Ball: Brass to BS 2874
 2. Seat: P.T.F.E.
 3. Seat retainer : Bronze to BS 1400
 4. Body : Bronze to BS2874
 5. Lever : mild steel covered by PVC
 6. Packing : P.T.F.E.
 7. Gland nut: Brass to BS2874

3.5 BUTTERFLY VALVES

- A. Compliant to BS5155 or EN593, PN 16.
- B. Application : Shut-off and limited flow control from DN 65 and above.
- C. EPDM bonded seat, conforms to BS155.
- D. Material Body : Cast iron, with extended neck to facilitate lagging on insulated pipelines, External protection is by epoxy paint.
- E. Disk: high grade spheroidal graphite iron with either a nylon coating or an electroless nickel coating or is made of aluminium bronze,
- F. Shaft: made from high tensile stainless steel. a thrust washer and pin is incorporated into the assembly to ensure the upper shaft is fully retained under pressure
- G. For smaller than DN150: Levers with position indicator and spring loaded trigger device.
- H. For DN150 and larger: Weather-proof Gearbox with handwheel with a worm and quadrant operation with adjustable stops at both the fully open and fully closed positions, self-locking capable for working under dry service.
- I. With motorized actuator where indicated.

3.6 DOUBLE REGULATING VALVE

- A. Application: Shut-off and flow regulation (balancing).
- B. Type: Y-pattern globe valve with tight shut-off, flow measurement ports and infinitely adjustable fine presetting controllable at any time and lockable. Fixed orifice type, Handwheel with a micrometer/ vernier device. Threaded to BS 21 or groove ended.
- C. Material:
1. Disc: DZR (Brass resistant to de-zincification)
 2. Seal: P.T.F.E.
 3. Body : Bronze to BS2874 or cast iron for DN65 and above.
 4. Lever : mild steel covered by PVC
 5. Bonnet: Bronze.

DIVISION 15
MECHANICAL SPECIFICATION

6. Stem: DZR.

3.7 CHECK VALVES

- A. Bronze Check Valve
1. Application : Prevention of flow reversal. Provide where shown on the drawings and as indicated, pipe sizes DN 50 and below are for water transfer application.
 2. Type : Swing check type to BS 5154, series B, noiseless application.
 3. Pattern : Horizontal or vertical (with upward flow).
 4. Ends : Screwed to BS 21.
 5. Materials:
 - a. Body: Bronze to BS 1400
 - b. Disk and Cap : 60140 Brass (20 min dia) BS 874 CZ18 No. 4 Bronze (20-50mm) Bs 1400 - LG2
- B. Cast Iron Check Valve
1. Application : Same as A, except for use for pipe sizes DN 65 and above.
 2. Type : Swing check to BS 5153 flanged to BS 4504 PN 16.
 3. Pattern : Horizontal or vertical (fluid flow towards upward direction).
 4. Material:
 - a. Disk: Cast iron and Bronze facing
 - b. Body seat ring : Bronze
 - c. Hinge Pin: Stainless steel, type 304
 - d. Hinge Pin bushes : Bronze.

3.8 STRAINERS

- A. Bronze Strainers
1. Application : Inlet connection to equipment, up to and including DN 50. Use for water base fluid transfer systems.
 2. Type : Y-type, Screwed-in cap, threaded to BS 21 or grooved, PN16, 24 bar hydraulically tested
 3. Materials :
 - a. Body : Bronze to BS 1400-LG2
 - b. Cap: Bronze to BS 1400-LG2
 - c. Cap Gasket: Compressed non-asbestos fibre.
 - d. Strainer screen: Perforated stainless steel sheet, having 0.75 mm diameter and 51 holes/cm².
- B. Cast Iron Strainers
1. Application: Inlet connection to equipmen for DN 65 and above. Use for water base fluid transfer systems.
 2. Type : Y-type, Screwed-in cap, flanged to BS 4504, PN16, 24 bar hydraulically tested
 3. Materials :
 - a. Body : Cast iron to BS 1452
 - b. Cap: Cast iron to BS 1452
 - c. Cap Gasket: Compressed non-asbestos fibre.
 - d. Strainer screen : Perforated stainless steel sheet, having 0.75 mm diameter and 51 holes/cm²

3.9 AUTOMATIC AIR VENTS

- A. Type: Ball Float. Reference to be made to approved manufacturer with special selection for each application.
- B. Application: Pipework in riser, loop in piping, heating and cooling coils, hot water heater, at highest point.
- C. Material: 30 000lbs minimum tensile Cast iron or bronze body with screwed inlet to BS 21 and stainless steel free floating lever with hemispherical chrome steel valve, with S/S internal components.
- D. Attachments: Integral detachable screw down air release cock with solid conical disc with machined body seat and integral isolator.
- E. Working Pressure: 16 bars.

PART 4 -

PART 5 - EXECUTION

5.1 INSTALLATION

- A. Install valves as indicated, according to manufacturer's written instructions.

DIVISION 15
MECHANICAL SPECIFICATION

- B. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the center of the pipe.
- F. Install valves in a position to allow full stem movement.
- G. Installation of Check Valves: Install for proper direction of flow as follows:
 - 1. Swing Check Valves: Horizontal position with hinge pin level.
 - 2. Wafer Check Valves: Horizontal or vertical position, between flanges.
 - 3. Lift Check Valve: With stem upright and plumb.

5.2 THREADED CONNECTIONS

- A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.
- B. Align threads at point of assembly.
- C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.
- D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

5.3 FLANGED CONNECTIONS

- A. Align flange surfaces parallel.
- B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.
- C. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

5.4

- A.

5.5 VALVE END SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:
 - 1. Copper Tube Size, DN65 and Smaller: Solder ends, except provide threaded ends for heating hot water and low-pressure steam service.
 - 2. Steel Pipe Sizes, DN65 and Smaller: Threaded or grooved end.
 - 3. Steel Pipe Sizes, DN80 and Larger: Grooved end or flanged.

5.6 APPLICATION SCHEDULE

- A. General Application: Use gate, ball, and butterfly valves for shutoff duty; globe, ball, and butterfly for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements.
- B. Domestic Water Systems: Use the following valve types:
 - 1. Gate Valves: PN16, bronze or cast-iron body to suit piping system.
 - 2. Ball Valves: PN16, with stem extension.
 - 3. Globe Valves: PN16, bronze or cast-iron body to suit piping system, and bronze or teflon disc.
 - 4. Butterfly Valves: Nickel-plated ductile iron, aluminum bronze, or elastomer-coated ductile iron disc; EPDM or Buna N sleeve and stem seals.
 - 5. Thermostatic valve: on hot water return pipe with thermostatic head, sensing return water temperature.
 - 6. Bronze Swing Check: PN16, with rubber seat.
 - 7. Check Valves: PN16, swing or wafer type as indicated.
- C. Chilled water / Heating Systems: Use the following valve types:
 - 1. Gate Valves: PN16, bronze body; or PN16, cast-iron body.
 - 2. Ball Valves: PN16, with stem extension and memory stop.
 - 3. Double Regulating valve: PN16, with fixed orifice flow measuring knobs.
 - 4. Butterfly Valves: Nickel-plated ductile iron, aluminum bronze, or elastomer-coated ductile iron disc; EPDM sleeve and stem seals.
 - 5. Check Valves: PN16, bronze body swing check with rubber seat; PN20, cast-iron body swing check; PN16, cast-iron body wafer check; or PN20, cast-iron body lift check.

SECTION 15140 - WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes domestic water piping from locations indicated to fixtures and equipment inside the building.
- B. Related Sections include the following:
 - 1. Section "Plumbing Specialties" for water distribution piping specialties.
 - 2. Section "Valves" for water valves and accessories.

1.2 DEFINITIONS (Abbreviations if existing)

- A. CPVC: Chlorinated polyvinyl chloride plastic.
- B. PPR: Polypropylene Random Copolymer sate.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing water piping systems with the following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Water Service Piping: 16 Bars.

1.4 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Sample for each: pipe, fitting and coupling.
- C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency to the European Norm of application.
- B. All of the foregoing works shall comply with the requirements of the latest edition of European Norm.
- C. Workmanship: Supplier approved skilled workmanship with proven experience in similar jobs.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Steel Pipe: DIN 2440, Seamless, galvanized, neoprene coated, medium weight. Include ends matching joining method.

1. Malleable-Iron fittings: ISO 5922 DIN 2950, smooth surface Hot dipped galvanized to ISO49. Unions with hexagonal-stock body with ball-and-socket, metal-to-metal, and female threaded ends.
 2. Fittings Threads: ISO 7/1 or DIN 2999 outside (male) connections “gas” tapered type (1:16 taper), internal (female) connection “gas” cylindrical type.
 3. Steel-Piping, Expansion Joints: Compound, galvanized, steel fitting with telescoping body and slip-pipe section. Include packing rings, packing, limit rods, chrome-plated finish on slip-pipe sections, and flanged ends.
- B. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.
- C. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.2 PVC PIPING

- A. PVC Schedule 80 Pipe: ASTM D 1785.
1. PVC Schedule 80 Fittings: ASTM D 2467, socket type.

2.3 STEEL PIPE AND FITTING

- A. Galvanized Steel seamless Pipe, DN 50 and Smaller: ASTM A 53, Type S Grade B, Schedule 40 or Standard weight, plain or threaded ends.
- B. Galvanized Steel seamless Pipe, DN 65 through DN 200: ASTM A 53, Type S, Grade B, Schedule 40 or standard weight, grooved ends.
- C. Unreinforced, welded, in-branch connections weaken a main pipeline; reinforcement is necessary unless wall thickness of both mains and branches is sufficient to sustain pressure.
- D. Coordinate flange class with products in other parts of this Section and in related Sections to correlate face size and bolt patterns.
- E. Malleable cast Iron Threaded Fittings: ASME B16.3, ASTM A197, Classes 250 and 300, hot-dip galvanized to ASTM153
- F. Malleable-Iron Unions: ASME B16.39; Classes 250, and 300, Galvanized.
- G. Grooved Mechanical-Joint Fittings: ASTM A 536, Grade 65-45-12 galvanized ductile iron; or ASTM A 47M, Grade 32510 galvanized malleable iron;
- H. Grooved Mechanical-Joint Couplings: Ductile- or malleable-iron housing and synthetic rubber gasket of central cavity pressure-responsive design; with nuts, bolts, locking pin, locking toggle, or lugs to secure grooved pipe and fittings. Mechanical couplings shall be rigid couplings with angle pad design (Rigid Zero Flex). Flexible couplings shall be used wherever flexibility is desired. Couplings shall be cast of ductile iron conforming to ASTM A-536, Grade 65-45-12 or malleable iron conforming to ASTM A-47, Grade 32510.
- I. Mechanical Coupling bolts shall be zinc plated (ASTM B-633) heat treated carbon steel track head conforming to physical properties of ASTM A-183, minimum tensile strength 110,000 psi (758450 kPa).
- J. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures. Shall be Grade “E” EPDM compound conforming to ASTM D-2000 designation 2CA615A25B24F17Z. UL classified to ANSI/NSF 61 for cold +86 degrees F (+30

degrees C) and hot +180 degrees F (+82 degrees C) potable water service. Temperature operating range -30 degrees F to +230 degrees F (-34 degrees C to +110 degrees C). (Note: Air systems without hydrocarbons.) Use Grade "L" Silicone compound (red color coded) for dry air service operating temperatures up to +350 degrees F (+177 degrees C).

2.4 COPPER PIPING

- A. Hard Copper Tube: ASTM B 88, types L and M (ASTM B 88m. types B and C), water tube, drawn temper.
- B. Copper Pressure fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
- C. Bronze Flanges: ASME B16.24, class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- D. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with boss-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.

2.5 POLYPROPYLENE (BETA PP-R)

- A. Pipes shall be manufactured from approved Raw materials in accordance with DIN 8078, and/ or especially to EN 15874.
- B. Produced pipes must be rated for at least class 2 Wall thicknesses. Mechanical Characteristics Mean outside diameter and out of roundness together with their tolerances must comply with: EN15874-2 or to DIN 8077. Exposed Pipes installations must be rated for class 2 and heat stabilized with aluminum foils.
- C. Class 2 PP-r should be under S3.2, SDR 7.4, and should be rated for 40 Degree C. under 18 bars; or for a rated 60 Degree C. and 12 bar water pressure to withstand a guaranteed theoretical life time of not less than 50 years.
- D. Marking of Pipe - All pipes shall bear permanent identification markings that will remain legible during the service life of the product. Marking on pipe shall include the following and shall be applied at intervals of not more than 1.5 meters:
- E. Trademark and Nominal diameter and thickness
- F. Standard PPr designation
- G. The Standard Dimension Ratio and Nominal Pressure
- H. Marking the product with the applicable standards designation
- I. Quality System used
- J. Date and time of manufacture reference
- K. Manufacturer's name and country of manufacture.
- L. Polypropylene Fittings
- M. All PP-r fittings supplied under this scope of work must be pressure rated PN25 and manufactured from the same material used to manufacture pipes and shall pass all tests required under: EN 15874-3 or DIN 16962/5 .

- N. All inserts used in the manufacturing of threaded fittings must be made of Nickel Plated Brass CW617N EURO. All threads must be made according to DIN 2999. All male threads must be serrated to ease the application of sealing tape. Male threaded fittings must have PP-r coverage extending to the tip of the insert (on the inner surface).
- O. Marking of Fittings- All fittings shall have permanent identification markings indicating the following:
 - P. 1- Trademark, size and pressure rating of fitting
 - Q. 2- Standard PP-r designation
 - R. 3- Month and Year stamp indicating period of manufacturing
- S. Joining Polypropylene Pipes and Fittings
- T. Socket Fusion Joining: This is the process used to join PP-r pipes to PP-r accessories. This form of joining requires a heating tools and sockets. In this process a pipe end and a fitting are heated simultaneously to fusion temperature (260 °C) using a heating bush and a heating spigot, and are then pushed together. Thus resulting in a homogeneous joint.
- U. Electro fusion joining: This technique is used strictly for repair and emergency work. In electro fusion,
- V. The pipe and electro fusion fitting are heated by means of resistance wires and fused together. Power is supplied through an automatic fusion control unit supplied by the manufacturer of fittings.
- W. Heat Fusion Training Services: Upon request, the Manufacturer shall provide training in the Manufacturer's recommended socket fusion and electro fusion procedures to the Contractor's installation personnel, and to inspectors representing the Owner.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated.
- C. Grooved joints may be used on aboveground grooved-end piping.
- D. Underground or Concealed in plaster or screed Domestic Water Service Piping: Use beta polypropylene random PP-R.
- E. Aboveground and exposed Water Piping: Use beta polypropylene random PP-R. .
- F. Mechanical /technical rooms, horizontal headers and vertical risers in shafts: Use beta polypropylene random PP-R.

3.2 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 bronze ball or gate valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.

2. Throttling Duty: Use bronze ball or globe valves for piping NPS 2 (DN 50) and smaller. Use cast-iron butterfly valves internally protected with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 3. Hot-Water-Piping, Balancing Duty: Double Regulating valves.
 4. Drain Duty: Hose-end drain valves.
- B. Cast-iron, grooved-end valves may be used with grooved-end piping.

3.3 PIPING INSTALLATION

- A. Refer to Section "Water Distribution" for site water distribution and service piping.
- B. Refer to Section "Basic Mechanical Materials and Methods" for basic piping installation.
- C. Extend domestic water service piping to exterior water distribution piping in sizes and locations indicated.
- D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Refer to Section "Basic Mechanical Materials and Methods" for wall penetration systems.
- E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside building at each domestic water service. Refer to Section "Meters and Gages" for pressure gages, and to Section "Plumbing Specialties" for drain valves and strainers.
- F. Install water-pressure regulators downstream from shutoff valves. Refer to Section "Plumbing Specialties" for water-pressure regulators.
- G. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
- H. Perform the following steps before operation:
1. Close drain valves and hose bibs.
 2. Open shutoff valves to fully open position.
 3. Open throttling valves to proper setting.
 4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
 5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 6. Remove filter cartridges from housings, and verify that cartridges are as specified for application where used and that cartridges are clean and ready for use.
- I. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.
- J. Check plumbing specialties and verify proper settings, adjustments, and operation.
1. Water-Pressure Regulators: Set outlet pressure at 80 psig (550 kPa) maximum, unless otherwise indicated.
- K. Energize pumps and verify proper operation.

3.4 JOINT CONSTRUCTION

- A. Refer to Section "Basic Mechanical Materials and Methods" for basic piping joint construction.
- B. Soldered Joints: Use BS 864, water-flushable, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

- C. Grooved Joints: Assemble joints with keyed-coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

3.5 VALVE INSTALLATION

- A. Install sectional valve close to water main on each branch and riser serving plumbing fixtures or equipment. Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.
- B. Install shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops. Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.
- C. Install drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
 - 1. Install hose-end drain valves at low points in water mains, risers, and branches.
 - 2. Install stop-and-waste drain valves where indicated.
- D. Install balancing valve in discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 (DN 50) and smaller and butterfly valves for piping NPS 2-1/2 (DN 65) and larger. Refer to Section "Plumbing Specialties" for balancing valves.
- E. Install calibrated balancing valves in discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Refer to Section "Plumbing Specialties" for calibrated balancing valves.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Refer to Section "Hangers and Supports" for pipe hanger and support devices.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch (10 mm).
- D. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. DN 20-32: Maximum span, 2 m; minimum rod size, 8 mm.
 - 2. DN 40-65: Maximum span, 2.5 m; minimum rod size, 10 mm.
 - 3. DN 80-100: Maximum span, 3 m; minimum rod size, 10 mm.
- E. Install supports for vertical steel piping every (3 m).
- F. Support piping at bends, elbows and tees with 2 supports at maximum 25 cm distance from the fitting.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to service piping with shutoff valve, and extend and connect to the following:

1. Transfer Systems: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Section "Plumbing Fixtures."
4. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 (DN 65) and larger.

3.8 FIELD QUALITY CONTROL

- A. Inspect domestic water 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/Engineer at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction/Engineer:
 - 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. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- B. Test domestic water piping 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 domestic water piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 3. Cap and subject piping to static water pressure of (500 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 5. Prepare reports for tests and required corrective action.

SECTION 15150 - SANITARY PIPEWORK AND RAINWATER SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK

- A. Discharge and Ventilating Pipework
- B. Rainwater Pipework
- C. Testing and Commissioning of the sanitary and rainwater pipework system.

1.2 RELATED DOCUMENTS

- A. The general requirements under apply to the work of this Section.
- B. Examine all other sections of the Specifications for requirements which may affect the work of this Section.
- C. Co-ordinate work with all other trades affecting or affected by the activities of this section. Co-operate with such other trades to assure the steady progress of all operations under the Contract.

1.3 APPLICABLE STANDARDS

- A. All of the foregoing works shall comply with the requirements of the latest edition of NF P 40-201 for Sanitary plumbing in residential buildings (DTU 60-1 and DTU 60-2).

1.4 DESIGN ATTRIBUTES

- A. The Plumbing Engineering Services are designed to achieve a standard of installation which provides the following:
 - 1. Free flowing drainage.
 - 2. Freely ventilating drainage.
 - 3. Cleanouts which are readily accessible and which will facilitate the easy maintenance of all parts of the respective systems.
 - 4. Durable materials of first class quality.
 - 5. Systems which maintain their integrity during their operational lives.
 - 6. Fully accommodates the constraints of the establishment and its intended use.
 - 7. The whole installation shall conform to the highest standard of Plumbing Engineering and shall be safe and hygienic in operation.
- B. The design requirements described above are detailed on the drawings and embodied in this specification. The contractor will be excepted to provide a neat and workmanlike installation, which is efficient in operation.
- C. Design is in general accordance with DTU 60-11.
- D. The drawings indicating rain water pipe work services, discharge and ventilating pipe work are intended to indicate generally the arrangement of pipe work required.
- E. The Contractor shall, in the execution of these works, ensure that all pipe work is routed in a manner which conforms to the design requirements.

1.5 STATUTORY UNDERTAKINGS/ADDITIONAL REQUIREMENTS UNDER BYE-LAWS

- A. Notice of any requisition or complaint or any communication whatsoever affecting the works shown or specified which is made to the Contractor by any Statutory or other competent Authority, via the Architect/Engineer shall be immediately confirmed in writing. The Architect/Engineer's written instructions shall be awaited before proceeding further with any portion of such works referred to. The Contractor shall be liable for any loss or cost of any subsequent other work found to be necessary by reason of this neglect to notify the Architect/Engineer at the time and in the manner herein prescribed.
- B. Verification of Local Authority and Utility Services Mains : The Contractor, prior to the commencement of any works shall:
 - 1. By consultation with the relevant Authorities, verify/determine the precise, size location, depth and extent of all existing services and any apparatus within or adjacent to the site boundaries, including the Client's existing services, which will affect the installation of new works.
 - 2. Should consultation with the relevant Authorities fail to satisfactorily provide the detailed information outlined above; the Contractor shall notify the Architect/Engineer accordingly and seek direction.

1.6 DISCREPANCIES

- A. The Tendered shall identify any discrepancies between the drawings, details, specification or schedules during the tender stage and shall inform the Architect/Engineer immediately and request formal instructions on the course of action to be taken.

1.7 CO-ORDINATE OF SERVICES

- A. The Contractor will be required to co-ordinate to ensure planned approach to the installation of the works. All works shall be installed so as to cause no hindrance or delay to other trades.

1.8 WORKMANSHIP

- A. The work is to be carried out by fully trained and qualified personnel.
- B. The Contractor is required to ensure that the whole of the installation complies with the Plumbing and Drainage/Mechanical Engineering drawings and details, with full account being taken of any co-ordination drawings that may be issued.
- C. The respective services shall be installed to true alignment and to the levels indicated on the drawings.
- D. All services shall be supported in the manner described in the Specification, unless particular manufacturer's requirements for support are more stringent than this Specification, in which case the manufacturer's instructions shall be complied with.

1.9 SAMPLES OF WORKMANSHIP

- A. The Contractor may be required to provide, free of charge, a sample of any of the specified materials. Elements of workmanship having been approved shall form the basis of the standard by which all other materials or workmanship are judged.
- B. Should the installation fail to comply with the standard or quality previously approved, then such work shall be rejected.
- C. In the absence of specified samples being required, then the accepted standards of material and workmanship laid down in the relevant DIN, NF or Codes of Practice, or equal approved shall apply.

1.10 SUBSTITUTION OF MATERIALS AND EQUIPMENT

- A. Substitution of specified materials or plant shall not be permitted without the written consent of the Architect/Engineer.
- B. In the event of non-availability of the specified material or plant, the contractor shall formally notify the Architect/Engineer and shall at the same time submit proposals for alternative materials for approval.

1.11 QUALITY ASSURANCE

- A. All products shall comply with and achieve third party certification where schemes exist for particular products or methods of manufacture. Reference to specific manufacturers, suppliers and specialist firms is made in this specification as an indication of required standards and quality. Equal other products shall be acceptable subject to the approval of the Architect/Engineer.

PART 2 - PRODUCTS

2.1 PVC AND PP PIPES AND FITTINGS

- A. All discharge, ventilating and rainwater pipes shall be of PVC-U to the latest European Norms and Standards, EN 1401-1, and EN 1401-2, with minimum 3mm thick pipes, with elastomeric ring seal, with seal ring expansion joints to accommodate thermal movement, or equal approved.
- B. Soil and waste drainage pipes shall be of Polypropylene according to EN 1451-1 norm.

2.2 CAST-IRON SOIL PIPING AND FITTING (NOT IN THE SCOPE)

- A. Hubless Pipe and Fittings: for accidental static water pressure of 10bars, according to EN 877.
 - 1. Piping: Cast iron to ISO 185 Grade 15 epoxy coated
 - 2. Coating:
 - a. Interior: Corrosion resistant Epoxy tar
 - b. Exterior: Anti-rust red primer.
 - 3. Couplings: assembly of stainless steel housing and fasteners, and an EPDM elastomere gasket in accordance to ISO 4633.
 - 4. Conformance: ISO 19522, NF A48-720, and DIN19522

2.3 DISCHARGE VENTILATING AND RAINWATER PIPEWORK SUPPORTS.

- A. All pipe work shall be supported at intervals not greater than those stated in the related section.
- B. All plastics pipe work shall be installed and fixed to accommodate thermal movement and be secured and fixed in accordance with manufacturer's instructions.
- C. PVC-U, or Polypropylene, pipe work shall be fixed with Mupro galvanized or equal approved steel holder bats plugged and screwed to walls with corrosion resistant steel screws.
- D. Stabilization brackets shall be provided at junctions and changes of direction to accommodate or restrain thermal movement.

- E. All horizontal PVC-U, or PP pipe work suspended from slabs or roof structures shall be supported by means of single pipe brackets or thermal movement limiters as appropriate on appropriately sized galvanized steel drop rods, supported by a secondary support system comprising mild steel channel and angle iron, secured by Instruct or equal and approved method. UPVC horizontal pipe work suspended from slabs or roof structures shall be supported by a similar secondary support system. Refer to Division 15 Section "Mechanical Vibration Controls and Seismic Restraints" for seismic-restraint devices.
- F. Support vertical piping and tubing at base and at each floor.
- G. Rod diameter may be reduced 1 size for double-rod hangers, with 10-mm minimum rods.
- H. Maximum spans below were taken from MSS SP-69 for water service and from model plumbing codes. Most restrictive piping and spacing dimensions are shown.
- I. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. DN 80: 1500 mm with 13-mm rod.
 - 2. DN 100 and DN 125: 1500 mm with 16-mm rod.
 - 3. DN 150: 1500 mm with 19-mm rod.
 - 4. DN 200 to DN 300: 1500 mm with 22-mm rod.
 - 5. DN 375: 1500 mm with 25-mm rod.
 - 6. Spacing for 3-m lengths may be increased to 3 m. Spacing for fittings is limited to 1500 mm.
 - 7. Install supports for vertical cast-iron soil piping every 4.5 m.

2.4 TRAPS

Traps on pipework shall have the following diameter:

RECOMMENDED TRAP SIZES	
Type of fixture	Trap size (mm)
Lavatory	32
Floor drain	50
Kitchen sink	50
Bathtub or shower	50

Traps for use with ranges of wash basins shall have adjustable inlets.

Traps types, unless noted otherwise, shall be:

Traps for wash basins	- bottle type, P outlet
Traps for sinks	- tubular type, P outlet
Floor Drain	- deep seal trap; P outlet

2.5 CLEANOUTS

- A. Floor cleanout (FCO) may be threaded caulked outlets.
- B. Floor cleanout (FCO) to be carefully set a locations and elevations indicated on the drawings. Set level and square with floor construction.
- C. Cleanout (CO) shall be located where shown on drawing. CO shall have threaded outlet.

2.6 VENTILATING PIPE ROOF TERMINALS

- A. To be PVC Pipe with weathering slate in aluminum and collar.

2.7 FLOOR DRAIN FOR TOILET

- A. PVC Floor drain shall conform to normal building European Standard; body shall be of shallow type with 5cm minimum water trap with three possible inlet of not less than DN50 and one outlet of DN75. Cover 200x200 to be adjustable and could be heavy UPVC or chrome plated bronze cover, of not less than 3mm thick
- B. Required Mechanical properties of PVC at 23°C are:
 - 1. Tensile strength at yield of 53 Mpa stress at break 43 Mpa
 - 2. Residual elongation at break 150%
 - 3. All according to ISO 527 Bending modular of elasticity ≥ 3.000 Mpa
 - 4. PVC density 1.43 Kg/dm³ according ISO 1183
 - 5. Vicat softening under 5Kg: 80°C according to EN 727. Floor drain to be similar to REDI, NICOLL.

2.8 FLOOR DRAIN FOR BALCONY AND FOR DRAINAGE.

- A. PVC Balcony Drain with adjustable cover of 150x150 with integral trap horizontal or vertical water outlet depending on the application. Outlet drainpipe to have DN50, cover to be adjustable similar in size and quality to the toilet floor drain. All PVC characteristics to be similar to floor drain for toilet. Floor Drain for balcony, similar to REDI, NICOLL, TERRAIN. with neoprene sealing membrane for waterproofing protection.

2.9 FLOOR DRAIN FOR KITCHEN AND FOR SERVICE AREAS

- A. Stainless steel Drain with adjustable cover of 150x150 with integral trap horizontal or vertical water outlet depending on the application. Outlet drainpipe to have DN100, cover to be adjustable. All stainless steel characteristics to be similar to floor drain from LUMATEC or equal.

2.10 FLOOR DRAIN FOR FLOWERBED.

- A. PVC Floor drain with perforated pipe extension replacing the grated cover, perforated pipe extension to have a geotextile protection. The body of the drain is similar to the balcony drain the cover to be similar to the roof drain, dome type to be secured on top of the pipe extension. Floor Drain for flowerbed, similar to REDI, NICOLL, TERRAIN.

2.11 FLOOR DRAIN FOR ROOF

- A. PVC Roof Drain trapped type with neoprene sealing membrane for waterproofing protection, outlet pipe dimension to be ϕ 100. Grating Cover to be domed type; to be fixed on top of the roof drain. Floor Drain for Roof similar to REDI, NICOLL, TERRAIN.

2.12 ROOF OUTLETS

- A. Roof drain, UPVC, large sump elevated dome type complete with lightweight, shock resistant, aluminium elevated dome strainer, non-puncturing flashing clamping collar with integral gravel guard and perforated extension sleeve.

2.13 COVER PLATES

- A. Cover plates to be plastics, or Chrome plated cast bronze, for use at pipe penetrations exposed to view at walls ceilings or floors.

2.14 WC PAN CONNECTORS

- A. Flexible self sealing WC pan connectors to French Standard, or BS 5627 as manufactured by Phetco (England) Ltd or Caradon Twyford Ltd.

2.15 CONDENSATE DRAIN PIPES

- A. Galvanized steel pipes seamless, threaded, with 9mm flexible elastomeric insulation.

2.16 TRENCH DRAIN

- A. Cover of the concrete channel is to be in cast iron tested for the car loads and for not less than one ton of dynamic load with seepage flange steel base to be anchored in the concrete edge, width of the grated cover to be as per the drawings and for not less than 300 mm.

PART 3 - EXECUTION

- A. Install supports according to Division 15 Section "Hangers and Supports."
- B. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- C. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- D. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- E. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. 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 was covered or concealed before it was tested.
 - 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. From 15 minutes before inspection starts to completion of inspection, water level must not drop. 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 with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 6. Prepare reports for tests and required corrective action.
- F. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 345 kPa operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.2 CLEANING

- A. Clean interior of piping. 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.

3.3 PROTECTION

- A. Exposed ABS and PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

SECTION 15430 — PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes plumbing specialties for the Water distribution systems and Soil, waste, and vent systems:
 - 1. Pressure Regulators
 - 2. Water hammer arresters
 - 3. Backflow preventers
- B. Related Sections include the following:
 - 1. Division 15 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, basic installation requirements, and labeling and identifying 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 "Water Distribution Piping" for water-supply piping and connections.
 - 4. 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 following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Water Distribution Piping PN 20.
 - 2. Soil, Waste, and Vent Piping: PN 6.
 - 3. Storm Drainage Piping: PN 6.
 - 4. Force-Main Piping: PN 10.

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. Water hammer arresters.
 - 2. Regulators.
 - 3. Backflow preventers
 - 4. Hose bibbs, hydrants, and sanitary post hydrants.
 - 5. Outlet boxes and washer-supply outlets.
 - 6. Hose stations.
 - 7. Vent caps, vent terminals.
- B. Calculation data for water hammer arrester selection.
- C. Reports: Specified in "Field Quality Control" Article.
- D. Maintenance Data: For specialties to include in the maintenance manuals specified Include the following:
 - 1. Retain and edit list below if required to include in maintenance manuals. Delete products not in

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. Listing and Labeling Agency Qualifications: "Nationally Recognized Testing Laboratory".
- 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 NSF 14, "Plastics Piping Components and Related Materials," for plastic potable-water piping components. Include marking "NSF-pw" on plastic potable-water piping and "NSF-dwv" on plastic drain, waste, and vent piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Water Hammer Arresters:
 - a. Josam Co.
 - b. Watts Industries, Inc.
 - c. Zurn Industries, Inc.; Hydromechanics Div.
 - 2. Water regulators and Backflow preventers
 - a. Watts
 - b. Wilkins (Zurn)

2.2 PRESSURE REDUCING VALVES (WATER REGULATORS)

- A. General: water regulators, consisting of a pre-loaded spring on diaphragm regulating water pressure in system rated PN 20, of size, flow rate, and inlet and outlet pressures as required by the system. Include integral factory-installed or separate field-installed Y-pattern strainer.
 - 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.
 - 4. Exterior Finish: Polished chrome-plate if used in chrome-plated piping system.
- B. Single-seated, direct-operated type, replaceable stainless steel seat.
- C. Nylon reinforced Buna-N diaphragm.
- D. Pilot-operated type, single- or double-seated, cast-iron-body main valve, with bronze-body pilot valve.

2.3 BACKFLOW PREVENTERS (ANTI-POLLUTION VALVE)

- A. General: Valve set designed to prevent contamination of water system from sub-systems.
 - 1. Working Pressure: PN20 minimum, unless otherwise indicated.
 - 2. NPS 2 (DN 50) and Smaller: Bronze body with threaded ends.
 - 3. NPS 2-1/2 (DN 65) 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.
 - 4. Interior Components: Corrosion-resistant materials.
 - 5. Strainer: On inlet.
- B. Pipe-Applied, Atmospheric-Type Vacuum Breakers: ASSE 1001, with floating disc and atmospheric vent.
- C. Double-Check-Valve Backflow Prevention Assemblies: UL 312, FM approved; with two bronze body spring loaded center guided check valves and two bronze ball valves, and four test cocks, 300-psig (2000-kPa) working-pressure gate valves.
 - 1. Maximum Pressure Loss: 5 psig (35 kPa)] through middle 1/3 of flow range.

2.4 DRAIN VALVES

- A. Hose-End Drain Valves: MSS SP-110, DN20 ball valve, rated for PN 16 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. 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.

2.5 MISCELLANEOUS PIPING SPECIALTIES

- A. Water Hammer Arresters: All stainless steel, properly sized according to connected installation, with nesting type bellows contained within a casing having sufficient displacement volume to dissipate the calculated kinetic energy of the piping system. ASME A112.26.1M, ASSE 1010, or PDI-WH 201. Sizes shall be based on water-supply fixture units, ASME A112.26.1M sizes A through F and PDI-WH 201 sizes A through F.
- B. Hose Bibs: 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.
- C. 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 counterflashing fitting.

- 1. Vent Cap: Extended model with field-installed, vandal-proof vent cap.
- D. Vent Caps: Aluminium body with threaded or hub inlet and vandal-proof design. Include vented hood and set-screws to secure to vent pipe.
- E. Vent Terminals: Commercially manufactured, shop-fabricated or field-fabricated, frost-proof assembly constructed of galvanized steel, copper, or lead-coated copper. Size to provide 25-mm enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing, as indicated.
- F. 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.

PART 3 - EXECUTION

3.1 PLUMBING SPECIALTY INSTALLATION

- A. General: Install plumbing specialty components, connections, and devices according to manufacturer's written instructions.
- B. Threaded Flanged or grooved end specialties to follow the pipes design and specified installation.
- C. Install expansion joints on vertical risers, stacks, and conductors as indicated.
- D. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
- E. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.
- F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor or as indicated. Size outlets as indicated.
- G. Fasten wall-hanging plumbing specialties securely to supports attached to building substrate if supports are specified and to building wall construction if no support is indicated.
- H. Fasten recessed, wall-mounting plumbing specialties to reinforcement built into walls.
- I. Secure supplies to supports or substrate.
- J. Install individual stop valve in each water supply to plumbing specialties. Use ball, gate, or globe valve if specific valve is not indicated.
- K. Install water-supply stop valves in accessible locations.
- L. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- M. Locate drainage piping as close as possible to bottom of floor slab supporting fixtures and drains.
- N. 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.
- O. Include wood-blocking reinforcement for recessed and wall-mounting plumbing specialties.

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. Install hoses between plumbing specialties and appliances as required for connections.
- C. Arrange for electric-power connections to plumbing specialties and devices that require power. Electric power is specified in Division 16 Sections.
- D. Supply Runouts to Plumbing Specialties: Install hot- and cold-water-supply piping of sizes indicated, but not smaller than required by authorities having jurisdiction.
- E. 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.
- F. 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.
- G. 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 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, hydrants, and hose bibbs.
 - 2. Open general-duty valves to fully open position.
 - 3. Remove and clean strainers.
 - 4. Verify that drainage and vent piping are clear of obstructions. Flush with water until clear.
- 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.

3.4 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.
 - 4. Schedule training with Owner with at least 7 days' advance notice.

3.5 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.

SECTION 15431 — PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Division-1 Specification sections apply to work of this section. All fixtures shall need prior approval from the Architect.

1.2 SCOPE OF WORK

- A. General: This Section specifies materials and methods required for providing and installing plumbing fixtures and trim. The work to be performed shall include all materials and equipment required for a complete operating installation.

1.3 STANDARDS AND CODES

- A. General: The work shall comply with or exceed the referenced standards and codes.
- B. Codes: The work shall comply with one of the following codes:
 - 1. BOCA
 - 2. NF and DTU .

1.4 WORK CLEANLINESS

- A. General: The Contractor shall proceed with all work in a clean and workmanlike manner. Contractor shall keep stored materials, storage areas, and installed systems free of dirt and debris.

1.5 QUALITY ASSURANCE

- A. General: All materials shall be clearly stamped or tagged as required by the referenced standards. Any materials or workmanship which in the opinion of the Engineer does not meet the referenced standards and codes shall be discarded and replaced at the Contractor's expense.
 - 1. Heavy duty cast iron closet carrier to ANSI A112.6M with adjustable closet connection, pylon feet ABS extension with integral test cap, chrome plated trim coated accessories and no seep fixture gasket.

PART 2 - FIXTURES

NB: Models and type of Sanitary Fixtures to be as per the approval and selection of the Architect in the absence of Architect information then plumbing fixture to be selected Vandal proof , heavy duty application similar to KERAMAG (public line model , Mondo Urinal with separating panel, WC model Virto).

2.1 LAVATORY COUNTERTOP

- A. White vitreous china lavatory, as Duravit model Mango No 243300, with mixer, complete with fixing brackets.

Lavatory shall be complete with the following trim and accessories, or approved equal:

1. Chrome plated Basin Mixer, similar to EUROPOLUS E, GROHE and pop up waste
2. Chrome plated 1"1/4 P-trap with wall tube and wall flange, adjustable type.
3. Chrome plated 1/2" angle supply and stop valve with 30 cm long tube, blue index.
4. Chrome plated 1/2" angle supply and stop valve with 30 cm long tube, red index.
5. Stainless steel soap dispenser as per Architect approval.

2.2 LAVATORY HALF PEDESTAL

- A. White vitreous china lavatory, as Duravit model Mango NO 253380 with half Pedestal, Bathroom range, with mixer, complete with fixing brackets.

Lavatory shall be complete with the following trim and accessories, or approved equal:

1. Chrome plated Basin Mixer, similar to EUROPOLUS E, GROHE and pop up waste
2. Chrome plated 1"1/4 P-trap with wall tube and wall flange, adjustable type.
3. Chrome plated 1/2" angle supply and stop valve with 30 cm long tube, blue index.
4. Chrome plated 1/2" angle supply and stop valve with 30 cm long tube, red index.
5. Stainless steel soap dispenser as per Architect approval.
6. Glass and stainless steel under mirror shelf, 80cm long approximately as approved by Architect.

2.3 LAVATORY FOR THE SERVICE AREA

- A. From Lecico model Zghorta or approved equal with the following as general guidelines.
- B. White vitreous china lavatory, with mixer, classic line from GROHE complete with fixing brackets. Lavatory shall be complete with the following trim and accessories, or approved equal:
1. Chrome plated mixer, high nozzle and pop up waste
 2. Chrome plated 1"1/4 P-trap with wall tube and wall flange, adjustable type.
 3. Chrome plated 1/2" angle supply and stop valve with 30 cm long tube, blue index.
 4. Chrome plated 1/2" angle supply and stop valve with 30 cm long tube, red index. Under mirror shelf as approved by Architect.

2.4 BIDET

- A. DURAVIT model Mango floor standing or approved equal, with the following as general guidelines.
- B. White vitreous china bidet, with mixer, Europlus from GROHE, complete with fixing brackets. Bidet shall be complete with the following trim and accessories, or approved equal:
1. Chrome plated mixer, high nozzle and pop up waste
 2. Chrome plated 1"1/4 P-trap with wall tube and wall flange, adjustable type.
 3. Chrome plated 1/2" angle supply and stop valve with 30 cm long tube, blue index.
 4. Chrome plated 1/2" angle supply and stop valve with 30 cm long tube, red index.

2.5 WATER CLOSET

- A. DURAVIT model Mango floor standing or approved equal, with the following as general guidelines.
- B. Water closet shall be white vitreous china washdown siphonal action hanged horizontal outlet with two (2) levels flushing tank shall be complete with the following:
1. Chrome plated water supply valve.
 2. Stainless steel paper roll holder and as approved by the Architect.
 3. Supports and all pipe works and accessories required for its installation, connection to water supply and drainage, Outlet connector supports, fixing its satisfactory operation.
 4. White solid plastic seat and cover complete with chrome plated hinge, rubber washers and plastic screws and nuts.

2.6 WATER CLOSET FOR THE SERVICE AREA

- A. From Lecico model Zghorta or approved equal, with the following as general guidelines.
- B. Water closet shall be white vitreous china washdown siphonal action complete with cistern:
 - 1. Chrome plated water supply valve.
 - 2. Supports and all pipe works and accessories required for its installation, connection to water supply and drainage, supports, fixing its satisfactory operation.
 - 3. White solid plastic seat and cover complete with chrome plated hinge, rubber washers and plastic screws and nuts.

2.7 SHOWER PAN AND SHOWER HEAD

- A. Shower pan shall be recessed tiles with the following trim and accessories, Duravit model Mango in ceramic ; or approved equal:
 - 1. Chrome plated thermostatic mixer Europlus from GROHE exposed spout and shower combination fittings AQUATOWER 3000 .
 - 2. Concealed pipe riser.

2.8 SHOWER PAN AND SHOWER HEAD FOR SERVICE AREA

- A. Shower pan shall be recessed tiles with the following trim and accessories from Lecico or approved equal:
 - 1. Chrome plated mixer from GROHE classic line with regulating self closing exposed spout and shower combination fittings 1/2" with 1/2" built-in connecting elbow. Diverter and multishower head with flexible
 - 2. Concealed pipe riser.
 - 3. Chrome plated 1/2" shower head with swivel nut. from GROHE

2.9 BATHTUBS

- 1. Bathtubs, white or colored vitreous enameled Acrylic heavy duty first quality bathtubs, size about 180 cm, with leg supports, antislip with hand support on both sides
- 2. Each bathtubs shall be complete with the following trim and accessories, or approved equal:
- 3. Bath waste and overflow complete with chrome plated 1/2" waste fitting with strainer, chrome plated 1"1/4 overflow fitting, automatic pop up, brass 1"1/2 x 2" trap with threaded outlet and plastic overflow pipe.
- 4. Europlus mixer from Grohe with complete, with diverter, shower head with multifunctional hand shower head
- 5. Built-in 3/4" multi way transfer valve with handle and wall flange.
- 6. Chrome plated 3/4" tube filler with wall flange.
- 7. Chrome plated hand spray, hose and wall hook and flange.
- 8. Chrome plated 1/2" shower arm and wall flange.
- 9. Chrome plated 1/2" shower head with swivel nut.
- 10. Vitreous china soap holder with hand grip bar, recessed type.

2.10 WATER TAP

- A. Water tap shall consist of:
 - 1. Wall mounted bibcock 1/2" with threaded outlet, Grohe No. 30006 or approved equal.
 - 2. Metal tube 1250 mm long with nozzle and loop with 1/2" nut, Grohe No. 28116 or approved equal.

2.11 SERVICE SINKS

- 1. Fixture Material: Stainless steel.
- 2. Stainless-Steel Thickness: 2.0 mm.

3. Mounting: Floor.
4. Rim Guard: Chrome plated, brass.
5. Faucet: Widespread, cast brass with supplies on 203-mm centers.
6. Faucet Mounting: Wall, centered on fixture.
7. Mixer from Grohe model Europlus (33933) with hose and shower

PART 3 - EXECUTION

3.1 VERIFICATION OF CONDITIONS

- A. Examine the substrates, adjoining construction, and conditions under which the work would be installed. Contractor shall correct unsatisfactory conditions detrimental to the timely and proper completion of the work. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: All wall-hung plumbing fixtures not supported on chair carriers shall be supported on wall hangers furnished with fixtures by the fixture manufacturer.
 1. Masonry Construction: Drill holes through tile walls for wall bolts.
Punched holes will not be allowed. Bolts shall support wall hangers and extend through tile walls ad through strap iron on the opposite side. Nuts and washers shall be installed so they can be buried in plaster or tile finish.

3.3 FIELD QUALITY CONTROL

- A. After the piping has been pressure tested, and the fixtures have been set and trim piped, but prior to practical completion, each fixture supply and drain shall be flowed to observe proper dynamic action to the set.
- B. Contractor shall notify the Engineer in writing at such time as the potable water systems, drainage, waste and vent piping, and plumbing fixtures are complete and ready to be flow tested on an acceptable basis.

3.4 EQUIPMENT HANDLING

- A. The Contractor shall furnish all supervision, labor, tools and equipment to relieve, unload, uncrate, inspect, move, disassemble, store, assemble, set in place, align and secure all equipment including all auxiliary items and components.
- B. Adequate weather protection of all equipment and equipment parts is to be furnished and maintained at all times by the Contractor
- C. Stored equipment shall be protected from the elements and physical damage. Installed equipment shall be protected from damage until final acceptance.

3.5 APPROVED MANUFACTURERS

- A. Toilet fixtures:
 1. Approval of a manufacturer does not necessarily constitute approval of his plumbing fixtures as equal to those specified. The Contractor shall submit to the approval of the Engineer a summary of the plumbing fixtures proposed indicating type, manufacturer and model number.
 2. The plumbing fixtures proposed type, manufacturer and model number are indicated in the Bill of Quantity.

SECTION 15441 –PUMPS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes pumps for the following systems:

N.B: Grooved system is not mandatory for piping joint.

1. Domestic Hot water return.
 2. Cold water pumps (general purpose)
 3. Heating water pumps and circulators.
 4. Packaged booster water pumping sets.
 5. Variables speed pumping systems.
- B. Related Sections include the following:
1. Division 15 Section "Valves" for pump valves and accessories.
 2. Division 15 Section "Water Distribution Piping"
 3. Division 16 Sections for power-supply wiring, field-installed disconnects electrical devices, and motor controllers.

1.2 SUBMITTALS

- A. Product Data: Include performance curves and rated capacities of selected models; shipping, installed, and operating weights; furnished specialties and accessories for each type and size of pump specified. Indicate pumps' operating point on curves.
- B. Shop Drawings: Show layout and connections for pumps. Include setting drawings with templates, directions for installation of foundation and anchor bolts, and other anchorages.
1. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
- C. Maintenance Data: For each pump specified to include in maintenance manuals specified in the general conditions.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of pumps through one source from a single manufacturer.
- B. Product Options: Drawings indicate size, profiles, connections, and dimensional requirements of pumps and are based on specific manufacturer types and models indicated. Other manufacturers' pumps with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
- C. Regulatory Requirements: Comply with provisions of the following:
1. DTU P 52-305, for piping materials and installation.
 2. EN 60204-1, EN60034-1, low voltage directive 72/ 23/EEC, EMC directive 89/336/EEC.EN 50081,82,-1&-2.
 3. Hydraulic Institute's "Standards for Centrifugal, Rotary & Reciprocating Pumps" for pump design, manufacture, testing, and installation.

- D. Packaged Booster sets: The pumping package shall be assembled by the pump manufacturer. The manufacturer shall assume "Unit Responsibility" for the complete pumping package. Unit responsibility shall be defined as responsibility for interface and successful operation of all system components supplied by the pumping system manufacturer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide pumps by one of the following:
1. In-Line Circulators:
 - a. Salmson
 - b. ITT Bell & Gossett.
 - c. Grundfos Pumps
 - d. Lowara
 2. Vertical In-Line:
 - a. Salmson
 - b. ITT Bell & Gossett.
 - c. Grundfos Pumps
 - d. Lowara
 3. Vertical multi-stage Pumps and packaged boosters:
 - a. a.Salmson
 - b. ITT Bell & Gossett.
 - c. Grundfos Pumps.
 - d. Lowara

2.2 PUMPS, GENERAL

- A. Description: Factory-assembled and -tested, single- or multi- stage, centrifugal pump units; suitable for potable-water service; with all-bronze or AISI 316 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 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.

2.3 COMPACT IN-LINE CIRCULATORS

- A. Description: Water cooled, horizontal, in-line, compact design, seal-less, centrifugal, and single stage. Include pump and motor assembled on a common shaft in hermetically sealed unit, without stuffing boxes or mechanical seals. Include lubrication of sleeve bearing and cooling of motor by circulating

pumped liquid through motor section, and isolation of motor section from motor-stator windings by corrosion-resistant, nonmagnetic, alloy liner. Include design rated for 16 bar minimum working pressure and a continuous water temperature of 107 deg C.

- B. Description: Cartridge type, horizontal, in-line, compact, seal-less, centrifugal, and single stage. Include pump and motor assembled on a common shaft in cartridge-type, hermetically sealed unit, without stuffing boxes or mechanical seals. Include isolation of motor section from motor-stator windings by corrosion-resistant, nonmagnetic, alloy liner. Include design rated for 16 bar minimum working pressure and a continuous water temperature of 107 deg C.
1. Casing: Cast bronze or cast iron, with stainless-steel liner, static O-ring seal to separate motor section from motor stator, and flanged piping connections.
 2. Impeller: Overhung, single suction, closed or open, nonmetallic.
 3. Shaft and Sleeve: Stainless-steel shaft with carbon-steel sleeve.
 4. Motor: Multi speed (min. 3).

2.4 IN-LINE CIRCULATORS

- A. Description: Horizontal, in-line, centrifugal, single-stage, bronze-fitted, radially split case design; rated for 16 bar minimum working pressure and a continuous water temperature of 107 deg C. Include the following.
1. Casing: Cast iron, with threaded companion flanges for piping connections smaller than DN65 and threaded gage tapings at inlet and outlet connections.
 2. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, and keyed to shaft.
 3. Shaft and Sleeve: Stainless Steel shaft with oil-lubricated Bronze alloy sleeve.
 4. Seals: Mechanical type. Include carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
 5. Pump Bearings: Oil-lubricated, bronze journal and thrust type.
 6. Motor Bearings: Oil-lubricated, sleeve type.
 7. Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.
 8. Motor: Resiliently mounted to pump casing.
 - a. Motor Size: For motors larger than 1/2 hp, select motor size that will not overload through full range of pump performance curve.

2.5 VERTICAL IN-LINE PUMPS

- A. Description: Vertical, in-line, centrifugal, flexible-coupled, single-stage, radially split case design. Include vertical-mounting, bronze-fitted design and mechanical seals rated for 16 bar minimum working pressure and a continuous water temperature of 107 deg C.
1. Casing: Cast iron, with threaded companion flanges for piping connections smaller than DN65, drain plug at low point of volute, and threaded gage tapings at inlet and outlet connections.
 2. Impeller: ASTM B 584, cast bronze, statically and dynamically balanced, closed, overhung, single suction, and keyed to shaft.
 3. Wear Rings: Replaceable, bronze casing ring.
 4. Shaft: Ground and polished stainless-steel shaft with axially split spacer coupling.
 5. Seals: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.
 6. Motor: Totally enclosed fan cooled IP44, Directly mounted to pump casing and with lifting and supporting lugs in top of motor enclosure.

2.6 VERTICAL MULTISTAGE PUMPS

- A. Description: Vertical, in-line, centrifugal, directly coupled multi-stage. Include vertical-mounting and mechanical seals rated for 16 bar minimum working pressure and a continuous water temperature of 107 deg C. Include the following:
1. Suction and discharge chamber and motor stand: Cast iron.
 2. Diffuser chamber: stainless steel.
 3. Impeller: Stainless steel.
 4. Shaft and Sleeve: Stainless steel shaft.
 5. Seals: Mechanical type, tungsten carbide mounted in stainless steel seal.
 6. Motor: Direct mounted to pump casing. Totally enclosed fan cooled IP55. With motor protection and effective motor starter.
 - a. Motor Size: For motors larger than 1/2 hp, select motor size that will not overload through full range of pump performance curve.
 - b. Lifting and Supporting Lug: Directly mounted in top of motor enclosure.

2.7 PUMP SPECIALTY FITTINGS

- A. Suction Diffuser: Angle or straight pattern, 16 bar pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory- or field-fabricated support.
- B. Triple-Duty Valve: Angle or straight pattern, 16 bar pressure rating, cast-iron body, pump-discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features.

2.8 PACKAGED BOOSTER SETS

- A. Unit to be packaged type comprising two or three pumps running in duplex or triplex as scheduled, bladder type compression steel tank, interconnecting pipework, valves, pressure switches and electric control panel all completely assembled on steel frame, piped, wired and tested at factory and delivered as complete packaged unit ready for installation and operation with simple piping and electrical connections.
1. Operation: unit to be automatically controlled by pressure switches starting pumps on fall of pressure in tank and stopping pumps on rise of pressure and by demand flow rate. Pumps to be sized so that each of the two (or three) main pumps would supply 50%(or 33%) of the total unit demand . Pumps should operate in sequence proportional to the demand with automatic alternation of the two (or three) pumps. Such control shall be achieved by means of flowmeter located at the main discharge of all sets. Depending on flow rate, the flowmeter shall signal the operation of the pumps in sequence.
 2. Staging of the pumps shall be accomplished by current sensing relays.
 3. Combination pressure reducing with non-slam check feature valves only shall be mounted in each pump circuit.
 4. Interconnecting piping and header shall be galvanized steel pipe.
 5. Isolation valves shall be provided for each pump-PRV set.
 6. Pressure gauges shall be mounted on the suction and discharge headers.
 7. The pumps shall be protected from thermal buildup, when running at no-flow, by a common thermal relief valve.
 8. The control panel shall be in a heavy gauge mild steel enclosure, finished with stoved hammer paint which includes motor starters, time delays, protected control circuit, transformer, current relays, hand-off-automatic switches for each pump, minimum run timers, and low suction pressure cut-out.

**2.9 ELECTRICAL POWER & CONTROL PANELBOARED FOR
PACKAGED BOOSTER PUMPS**

A. FUNCTIONAL FEATURES

1. Description: Modular arrangement of motor controllers, control devices, overcurrent protective devices, transformers, panel boards, instruments, indicating panels, blank panels, and other items mounted in compartments of motor-control center as indicated.
2. Motor-Controller Units: Combination controller units of types and with features, ratings, and circuit assignments indicated.
3. Units have short-circuit current ratings equal to or greater than short-circuit current rating of motor-control center section.
4. Overcurrent Protective Devices: Types of devices with features, ratings, and circuit assignments indicated.
5. Transient Voltage Surge Suppressors: Connected to motor-control center bus.
6. Coordinate paragraphs below with Drawings. Indicate in schedule sizes of future controllers to be accommodated.
7. Spaces and Blank Units: Compartments fully bused and equipped, ready for insertion of units.
8. Spare Units: Type, sizes, and ratings as indicated, and installed in compartments indicated "spare."

B. MAGNETIC MOTOR CONTROLLERS

1. Description: full voltage, nonreversing, across the line, unless otherwise indicated.
2. Control Circuit: 220 V; obtained from integral control isolation power transformer, unless otherwise indicated. Include a control power transformer with adequate capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.
3. Combination Controller: Factory-assembled combination controller and disconnect switch with overcurrent protection.
4. Moulded case nonfusible Disconnect: heavy-duty, nonfusible switch.
5. Molded case circuit-Breaker Disconnect: motor-circuit protector (magnetic trip only) with field-adjustable short-circuit trip coordinated with motor locked-rotor amperes.
6. Overload Relay: Ambient-compensated type with inverse-time-current characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect, and with appropriate adjustment for duty cycle.
7. Multi speed-Motor Controller: Match controller to motor type, application, and number. Modify controller specifications to suit Project. Delete types below if not used. Coordinate with Drawings. See Evaluations for selection considerations.
8. Star-Delta Controller: closed transition with adjustable time delay and overload protection.
9. Part-Winding Controller: closed transition with separate overload relays for starting and running sequences.
10. Contactor: To IEC standards 947-4-1, AC-3 or AC-4 rated as required by the application, in coordination type 2 with motor circuit breaker, thermal relay and motor nameplate data.

11. Solid-State, Reduced-Voltage Controller: Suitable for use with polyphase or single phase (as indicated on drawings), induction motors.
12. It shall comply with IEC 801-2, level 3 and IEC 801-4 level 4 for immunity to interference and directive 89/336/EEC for EMC requirements and IEC 664 for clearances and creepage distances.
13. Adjustable acceleration rate control uses voltage or current ramp, and adjustable starting torque control has up to 500 percent current limitation for 20 seconds.
14. Surge suppressor in solid-state power circuits provides 3-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.
15. LED indicators show motor and control status, including the following conditions:
 1. Control power available.
 2. Controller on.
 3. Overload trip.
 4. Loss of phase.
 5. Shorted silicon-controlled rectifier.
 - ii. Automatic voltage-reduction controls to reduce voltage when motor is running at light load.
 - iii. Motor running contactor operates automatically when full voltage is applied to motor.

2.10 VARIABLE-SPEED DRIVES

- A. Description: Variable speed drive controller, listed and labeled as a complete unit and arranged to provide soft starting of a recognized standard, induction motor by adjusting output voltage and frequency.
- B. It shall comply with IEC 801-2, level 3 and IEC 801-4 level 4 for immunity to interference and directive 89/336/EEC for EMC requirements and IEC 664 for clearances and creepage distances.
- C. Design and Rating: Match type pumps or fans; and type of connection used between motor and load such as direct or through a power-transmission connection.
- D. Isolation Transformer: Match transformer voltage ratings and capacity to system and motor voltages; and controller, motor, drive, and load characteristics.
- E. Output Rating: 3-phase, 0.5 to 320 Hz, with torque constant as speed changes.
- F. Starting Torque: 100 percent of rated torque or as indicated.
- G. Speed Regulation: Plus or minus one percent.
- H. Ambient Temperature: 0 to 40 deg C.
- I. Efficiency: 95 percent minimum at full load and 320 Hz.
- J. Isolated control interface allows controller to follow 1 of the following over an 11:1 speed range:
 1. Electrical Signal: 4 to 20 mA at 24 V.
- K. Internal Adjustability: Include the following internal adjustment capabilities:
 1. Minimum Speed: 5 to 25 percent of maximum rpm.

2. Maximum Speed: 80 to 100 percent of maximum rpm.
 3. Acceleration: 2 to 22 seconds.
 4. Deceleration: 2 to 22 seconds.
 5. Current Limit: 50 to 110 percent of maximum rating.
- L. Self-protection and reliability features include the following:
1. Input transient protection by means of surge suppressors.
 2. Snubber networks to protect against malfunction due to system voltage transients.
 3. Motor Overload Relay: Adjustable and capable of NEMA 250, Class 10 performance.
 4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
 5. Instantaneous overcurrent trip.
 6. Loss of phase protection.
 7. Reverse phase protection.
 8. Under- and overvoltage trips.
 9. Overtemperature trip.
 10. Short-circuit protection.
- M. Automatic Reset/Restart: Attempt 3 restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Restarting during deceleration will not damage controller, motor, or load.
- N. Power-Interruption Protection: Prevents motor from reenergizing after a power interruption until motor has stopped.
- O. Status Lights: Door-mounted LED indicators to indicate the following conditions:
1. Power on.
 2. Run.
 3. Overvoltage.
 4. Line fault.
 5. Overcurrent.
 6. External fault.
- P. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.
- Q. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate controller output current, voltage, and frequency.
- R. Automatic Bypass: Magnetic contactor arranged to safely transfer motor between controller output and bypass controller circuit when motor is at zero speed. Bypass shall consist of a main power disconnect with ground fault protection, a pair of interlocked contactors and a motor overload relay. An Additional manual Controller-off-bypass selector switch indicator lights set and indicate mode selection.
- S. Integral disconnect.
- T. Isolating Switch: Non-load-break switch arranged to isolate variable-frequency controller and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.
- U. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.
- V. The variable speed set control system and sequence should be controlled independently or could be included in the BMS section if installed .

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water distribution piping to verify actual locations of connections before pump installation.

3.2 INSTALLATION

- A. Install pumps according to manufacturer's written instructions and with access for periodic maintenance, including removing motors, impellers, couplings, and accessories.
- B. Support pumps and piping so weight of piping is not supported by pumps.
- C. Delete paragraph below if horizontal in-line pumps are specified and are small. Circulators do not require separate support.
- D. Suspend horizontal in-line pumps independent of piping. Use continuous-thread hanger rods and vibration isolation hangers of sufficient size to support pump weight. Fabricate brackets or supports as required. Refer to Division 15 Section "Hangers and Supports" for materials.
- E. Suspend vertical in-line pumps independent of piping. Use continuous-thread hanger rods and vibration isolation hangers of sufficient size to support pump weight. Refer to Division 15 Section "Hangers and Supports" for materials.

3.3 CONNECTIONS

- A. Coordinate piping installation and specialty arrangement requirements with schematics on Drawings.
- B. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping and specialties. The following are specific connection requirements:
- C. Connect water distribution piping to pumps. Install suction and discharge pipe equal to or greater than size of pump nozzles. Refer to Division 15 Section "Water Distribution Piping."
- D. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping. Refer to Division 15 Section "Valves" for general-duty valves and Division 15 Section "Plumbing Specialties" for strainers.
- E. Install pressure gages at suction and discharge of pumps. Install at integral pressure-gage tapings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Refer to Division 15 Section "Meters and Gages" for pressure gages and gage connectors.
- F. Electrical wiring and connections are specified in Division 16 Sections.
- G. Ground equipment.
- H. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 COMMISSIONING

- A. Check suction piping connections for tightness.

- B. Clean strainers on suction piping.
- C. Controls: Set for automatic starting and stopping operation.
- D. Final Checks before Starting: Perform the following preventive maintenance operations:
- E. Lubricate oil-lubricated-type bearings.
- F. Verify that pump is free to rotate by hand and that pump for handling hot liquids is free to rotate with pump hot and cold. Do not operate pump if it is bound or drags, until cause of trouble is determined and corrected.
- G. Verify that pump controls are correct for required application.
- H. Starting procedure for pumps is as follows:
- I. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
- J. Open circulating line valve if pump should not be operated against dead shutoff.
- K. Start motor.
- L. Open discharge valve slowly.
- M. Check general mechanical operation of pump and motor.
- N. Close circulating line valve once there is sufficient flow through pump to prevent overheating.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain pumps as specified below:
- B. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, trouble-shooting, servicing, and maintaining pumps.
- C. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
- D. Schedule training with Owner with at least seven days' advance notice.

SECTION 15480 –STORAGE DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following for domestic water systems:
 - 1. Storage domestic water heaters.
 - 2. Accessories.

1.3 SUBMITTALS

- A. Product Data: For each type and size of water heater. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
- B. Shop Drawings: Detail water heater assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Piping Diagrams. Differentiate between manufacturer-installed and field-installed piping.
- C. Product Certificates: Signed by manufacturers of water heaters certifying that products furnished comply with requirements.
- D. Maintenance Data: For water heaters to include in maintenance manuals specified in the general specification
- E. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.
- B. ASME standards listed below can have equivalent European standards.
- C. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:
 - 1. ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," for commercial water heaters.

1.5 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include heating elements and storage tanks.
2. Warranty Period: From date of Substantial Completion:
 - a. Heating Elements: 3 year.
 - b. Storage Tanks: 3 year.

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. Storage, Electric Water Heaters:
 - a. Rycroft
 - b. Dedietrich.
 - c. A. O. Smith Water Products Co.

2.2 STORAGE WATER HEATERS

- A. Storage Tank Construction: Steel with minimum 1000-kPa working-pressure rating.
1. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, drain, anode rod, and controls as required. Attach tappings to tank before testing and labeling. Include BS, pipe thread.
 2. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets. Finishing being glass lined inner tank.
 3. Insulation: Comply with ASHRAE 90.2. Surround entire storage tank except connections and controls.
 4. Jacket: Steel, with enameled finish.
 - a. Shape: Cylindrical.
 - b. Color: White, unless otherwise indicated.
- B. Anode Rods: Factory installed, magnesium, removable type.
- C. Dip Tube: Stainless steel, Factory installed. Not required if cold-water inlet is near bottom of storage tank.
- D. Drain Valve: corrosion-resistant metal, factory installed.
- E. Thermometers dial type in double setting: operation and security.

2.3 TUBE TANK HEATERS

- A. Tank heating units are used for solar heating water and are specifically engineered for installation in water storage tanks. The heating medium will be hot water.
- B. solar units are manufactured from 3/4" OD 20 gauge seamless deoxidized drawn copper tubing, formed into "U" shapes with ends expanded into a brass tube sheet. Where necessary, the assemblies are installed with tube bundle supports and with spacers to keep tubes in alignment. Heater heads are constructed of flanged hot deep galvanized steel, or optional methods, depending upon working pressure.

2.4 WATER HEATER ACCESSORIES

- A. Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than heat-exchanger working-pressure rating.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

- A. Install water heaters, level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
- B. Anchor water heaters to substrate.
- C. Install pressure relief valves. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.
- D. Install water heater drain piping as indirect waste to spill into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 15 Section "Plumbing Specialties" for drain valves.
- E. Install water regulator, with integral bypass relief valve, in booster-heater inlet piping and water hammer arrester in booster-heater outlet piping.
- F. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.
- G. Fill water heaters with water.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to machine to allow service and maintenance.
- C. Connect hot- and cold-water piping with shutoff valves and unions. Connect hot-water-circulating piping with shutoff valve, check valve, and union.
- D. Make connections with dielectric fittings where piping is made of dissimilar metal.
- E. Ground equipment.

3.3 FIELD QUALITY CONTROL

- A. Engage a factory-authorized service representative to perform startup service.
- B. In addition to manufacturer's written installation and startup checks, perform the following:
 - 1. Verify that piping system tests are complete.
 - 2. Check for piping connection leaks.
 - 3. Check for clear relief valve inlets, outlets, and drain piping.
 - 4. Check the recovery time for heating the water inside the tank
 - 5. Check operation of circulators.

6. Test operation of safety controls, relief valves, and devices.
7. Adjust hot-water-outlet temperature settings. Do not set above 60 deg C unless piping system application requires higher temperature.
8. Balance water flow through manifolds of multiple-unit installations.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water heaters.
 1. Train Owner's maintenance personnel on procedures for starting and stopping, troubleshooting, servicing, and maintaining equipment.
 2. Schedule training with Owner, through Architect, with at least seven days' advance notice.

SECTION 15738 - SPLIT-SYSTEM AIR-CONDITIONING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes split-system air-conditioning and heat pump units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.3 DEFINITIONS

Factory-assembled and tested air-cooled condensing units, to operate for cooling and heating, consisting of casing, compressors, condensers, coils, condenser fans and motors, and unit controls

- A. Evaporator-Fan Unit: The part of the split-system air-conditioning unit that contains a Dx coil for cooling (heat rejection for heating operation in heat pump units) and a fan to circulate air to conditioned space, electric motor, condensate drain pan, galvanized steel casing panels, filter, electric junction box and fan switch.
- B. Compressor-Condenser Unit: The part of the split-system air-conditioning unit that contains a refrigerant compressor and a coil for condensing refrigerant (evaporator for heating operation in heat pump units) and a fan to cool the condenser.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Diagram power, signal, and control wiring and differentiate between manufacturer-installed and field-installed wiring.
- C. Maintenance Data: For split-system air-conditioning units to include in maintenance manuals.
- D. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Other manufacturers' systems with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- C. Euro vent Certifications; provide air conditioning units which comply with air conditioning and refrigeration certification programs, Eurovent certifications or unit should be rated in accordance with the latest edition of ARI standard 240
- D. ANSI/ASHRAE Compliance; comply with installation requirements of ANSI/ASHRAE 15: "Safety Code for Mechanical Refrigeration". ANSI/ARI 310, and ASHRAE standard 90-75 Section 6.3.

1.6 COORDINATION

- A. Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 3 Section "Cast-in-Place Concrete."
- B. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations.

1.7 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
- C. Warranty Period: one year (minimum) from date of substantial completion. Warranty against corrosion should be for a minimum of five years.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set of filters for each unit.
 - 2. Fan Belts: One set of belts for each unit.

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:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carrier Air Conditioning; Div. of Carrier Corp.
 - 2. Lennox Industries Inc.
 - 3. Trane Co. (The); Unitary Products Group.
 - 4. York International Corp.

2.2 CONCEALED EVAPORATOR-FAN COMPONENTS

- A. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
 - 1. Insulation: Faced, glass-fiber duct liner.
 - 2. Drain Pans: Galvanized steel, with connection for drain; insulated.
- B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, with 16mm solder joint copper tube connections and with thermal-expansion valve. Coil is to be leak tested at factory to 2352 Kpa minimum air pressure under water.
- C. Fan: Forward-curved, double-width wheel of special plastic or galvanized steel, double inlet, with adjustable belt drive.
- D. Fan Motor:
 - 1. General: Refer to Division 15 Section "Motors" for general requirements.
 - 2. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily.
 - 3. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven loads will not require motor to operate in service factor range.
 - 4. Temperature Rating: 50 deg C maximum temperature rise at 40 deg C ambient for continuous duty at full load (Class A Insulation). Static pressure should be as scheduled with a minimum of 50 Pascal
 - 5. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.
 - 6. Bases: Adjustable.
 - 7. Bearings: The following features are required:
 - 8. Ball or roller bearings with inner and outer shaft seals.
 - 10. Permanently lubricated.
 - 11. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
 - 12. Enclosure Type: The following features are required:
 - 13. Open drip proof motors where satisfactorily housed or remotely located during operation.
 - 14. Overload Protection: Built-in, automatic reset, thermal overload protection.
 - 16. Noise Rating: Quiet.
 - 17. Efficiency: Energy-efficient motors shall have a minimum efficiency as scheduled according to IEEE 112, Test Method B. If efficiency is not specified, motors shall have a higher efficiency than "average standard industry motors" according to IEEE 112, Test Method B.
 - 18. Nameplate: Indicate full identification of manufacturer, ratings, characteristics, construction, and special features.
 - 19. Starters, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 16 Sections.
- E. Disposable Filters: 1 inch (25 mm) thick, in fiberboard frames.

- F. Cleanable Filters: 1 inch (25 mm) thick, in aluminium wire mesh.
- G. Wiring Terminations: Connect motor to chassis wiring with plug connection.

2.3 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

- A. Casing: Steel, finished with baked enamel, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing. Test certificate to show the adaptability of the unit to withstand the corrosive outdoor ambient conditions,.
- B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - 1. Compressor Type: Reciprocating, or Scroll with R 410.
 - 2. Refrigerant cooled compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
- C. Refrigerant Coil: internally enhanced seamless Copper tubes, with mechanically bonded aluminum fins protected by epoxy coated, with 16mm solder joint copper tube connections and with thermal-expansion valve. Coil is to be leak tested at factory to 2352 Kpa minimum air pressure under water.
- D. Heat Pump Components: Reversing valve and low-temperature air cut-off thermostat.
- E. Fan: Aluminum -propeller type directly connected to motor.
- F. Motor: Permanently lubricated, with integral thermal-overload protection.
- G. Low Ambient Kit: Permits operation down to 45 deg F (7 deg C).
- H. The condenser coil should be protected by factory protection paint allowing a durable coil and fins for at least five years.

2.4 ACCESSORIES

- A. Sight glass.
- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install unit's level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install ground-mounted, compressor-condenser components on 4-inch- (100-mm-) thick, reinforced concrete base; 4 inches (100 mm) larger on each side than unit. Concrete, reinforcement, and formwork are specified in Division 3, "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.

- D. Install ground-mounted, compressor-condenser components on polyethylene mounting base.
- E. Install compressor-condenser components on restrained, spring isolators with a minimum static deflection of 1 inch (25 mm).
- F. Connect recharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to unit to allow service and maintenance.
- C. Unless otherwise indicated, connect piping with unions and shutoff valves to allow units to be disconnected without draining piping. Refer to piping system Sections for specific valve and specialty arrangements.
- D. Ground equipment.
 - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

- A. Installation Inspection: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including piping and electrical connections, and to prepare a written report of inspection.
- B. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
- C. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new components, and retest.
- D. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 COMMISSIONING

- A. Engage a factory-authorized service representative to perform startup service.
- B. Verify that units are installed and connected according to the Contract Documents.
- C. Lubricate bearings, adjust belt tension, and change filters.
- D. Perform startup checks according to manufacturer's written instructions and do the following:
 - 1. Fill out manufacturer's checklists.
 - 2. Check for unobstructed airflow over coils.
 - 3. Check operation of condenser capacity-control device.
 - 4. Verify that vibration isolation devices and flexible connectors dampen vibration transmission to structure.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.
 - 1. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, troubleshooting, servicing, and maintaining units.
 - 2. Review data in maintenance manuals. Refer to Division 1 Section "Contract Closeout."
 - 3. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
 - 4. Schedule training with Owner, through Architect, with at least seven days' advance notice.

SECTION 15815- METAL DUCTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes rectangular and round metal ducts and plenums for heating, ventilating, and air-conditioning systems.
- B. Refer to Division 15 Section "Duct Insulation" for insulation requirements.
- C. Refer to Division 15 Section "Duct Accessories" for dampers, sound-control devices, duct-mounted access doors and panels, turning vanes, and flexible ducts.

1.2 SUBMITTALS

- A. Product Data: For sealing materials indicated.
- B. Shop Drawings:
 - 1. Duct layout indicating pressure classifications, sizes, invert levels and distances from walls and columns on plans.
 - 2. Reinforcement and spacing.
 - 3. Seam and joint construction.
 - 4. Penetrations through fire-rated and other partitions.
 - 5. Terminal unit, coil, and humidifier installations.
 - 6. Hangers and supports, including methods for building attachment, vibration isolation, seismic restraints, and duct attachment.
- C. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Welding Standards: Qualify welding procedures and welding personnel to perform welding processes for this Project according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports; AWS D1.2, "Structural Welding Code--Aluminum," for aluminum supporting members; and AWS D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. Mockups: Before installing duct systems, erect mockups representing system. Build mockups to comply with the following requirements, using materials indicated for completed Work:
 - 1. Include the minimum number of each of the following features and fittings:
 - a. Five transverse joints.
 - b. One access door.
 - c. Two typical branch connections, each with at least one elbow.
 - d. Two typical flexible duct or flexible connector connections for each duct and apparatus.
 - 2. Obtain Consultant's approval of mockups before starting Work.
 - 3. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.

PART 2 - PRODUCTS

2.1 METAL DUCT MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, Z275 (G90) coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- C. Tie Rods: Galvanized steel, 6-mm minimum diameter for 900-mm length or less; 10-mm minimum diameter for lengths longer than 900 mm.
- D. Fabricate hood exhaust ducts with 1.5-mm- thick, carbon-steel sheet for concealed ducts and 1.3-mm- thick stainless steel for exposed ducts. Weld and flange seams and joints. Comply with NFPA 96.
- E. Fabricate dishwasher hood exhaust ducts with 1.3-mm- thick stainless steel. Weld and flange seams and joints.

- F. Acid-Resistant Ducts: PVC-coated galvanized steel.
- 2.2 SEALING MATERIALS
- A. Joint and Seam Tape: 50 mm wide; glass-fiber fabric reinforced.
 - B. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant, formulated with a minimum of 75 percent solids.
- 2.3 HANGERS AND SUPPORTS
- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for building materials.
 - B. Hanger Materials: Galvanized, sheet steel or round, threaded steel rod.
 - C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
 - D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
- 2.4 HOOD DUCTS
- A. Stainless Steel: ASTM A 480/A 480M, Type 304, sheet form with No. 4 finish for surfaces of ducts exposed to view; and No. 1 finish for concealed ducts.
 - B. Fabricate range hood exhaust ducts with 1.0-mm thick, stainless steel carbon-steel sheet for concealed ducts. Welded seams and joints. Comply with NFPA 96. Insulate as required in division 15 "Duct Insulation" section,
- 2.5 DUCT FABRICATION
- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with galvanized, sheet steel, according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 - B. Static-Pressure Classifications: Unless otherwise indicated, construct ducts to the following:
 - 1. Supply Ducts: 500 Pa.
 - 2. Return Ducts: 500 Pa, negative pressure.
 - 3. Exhaust Ducts: 500 Pa, negative pressure.
 - C. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 480 mm and larger and 0.9 mm thick or less, with more than 0.93 sq. m of unbraced panel area, unless ducts are lined.
 - D. Round Supply And Exhaust Fitting Fabrication: Fabricate 90-deg ree tees and laterals and conical tees to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal seam straight duct.
 - 1. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from body onto branch tap entrance.
 - 2. Elbows: Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate bend radius of die-formed, gored, and pleated elbows one and one-half times elbow diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
 - 3. 90-Degree, Two-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material-handling Classes A and B; and only where space restrictions do not permit using 1.5 bend radius elbows. Fabricate with single-thickness turning vanes.
 - 4. Round Elbows, 200 mm and Smaller: Fabricate die-formed elbows for 45- and 90-degrees elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configuration or nonstandard diameter elbows with gored construction.
 - 5. Round Elbows, 225 and larger: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees, unless space restrictions require a mitered elbow. Fabricate nonstandard bend-angle configuration or nonstandard diameter elbows with gored construction.
- 2.6 DUCT FIRE PROOF COATING
- A. Description: Fire proof coating shall be specifically made for sheet metal ducts application. The coating shall ensure 1 hr fire resistance at 400 deg C

- B. Type: Mineral Fibre based or Calcium Silicate.
- C. Application: BY pump injection. Application should be done by the approved manufacturer representative.
- D. Compliance: Material should have test certificates from acknowledged certification bodies to be according to BS 476 (Part B) or equivalent European Norm.
- E.

PART 3 -

PART 4 - EXECUTION

4.1 INSTALLATION

- A. Duct installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts, fittings, and accessories.
- B. Construct and install each duct system for the specific duct pressure classification indicated.
- C. Install round ducts in lengths not less than 3.7 m, unless interrupted by fittings.
- D. Install ducts with fewest possible joints.
- E. Install fabricated fittings for changes in directions, changes in size and shape, and connections.
- F. Install couplings tight to duct wall surface with a minimum of projections into duct.
- G. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- I. Install ducts with a clearance of 25 mm, plus allowance for insulation thickness.
- J. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless specifically indicated.
- K. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- L. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Use wooden frame sleeve for all duct penetration through walls.
- N. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same metal thickness as duct. Overlap opening on four sides by at least 38 mm.
- O. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire damper, sleeve, and firestopping sealant. Fire and smoke dampers are specified in Division 15 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 7 Section "Through-Penetration Firestop Systems."

4.2 JOINT AND SEAM SEALING

- A. Seam And Joint Sealing: Seal duct seams and joints according to the duct pressure class indicated and as described in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
 - 1. Pressure Classification Less Than 500 Pa: Transverse joints.
 - 2. Seal externally insulated ducts before insulation installation.

4.3 HANGERS AND SUPPORTS

- A. Install rigid round and rectangular metal ducts with support systems indicated in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Refer to drawings for construction and reinforcement schedule.
- C. Support horizontal ducts within 600 mm of each elbow and within 1200 mm of each branch intersection.
- D. Support vertical ducts at a maximum interval of 3 m and at each floor.
- E. Install concrete inserts before placing concrete.

4.4 CONNECTIONS

- A. Connect equipment with flexible connectors according to Division 15 Section "Duct Accessories."
- B. For branch, outlet and inlet, and terminal unit connections, comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- C. Proposed schedule to fit with SMACNA as per the details;
- D.
- E.

SECTION 15851 - CENTRIFUGAL FANS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. Centrifugal fans for indoor or outdoor installations.
 - 2. Centrifugal In-line fans
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section "Vibration Control" for vibration hangers and supports.
 - 2. Section "Control Systems Equipment" for control devices.
 - 3. Division 16 Section "Disconnects and Circuit Breakers" for disconnect switches.
 - 4. Division 16 Section "Motor Controllers" for motor starters.

1.2 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base air ratings on sea-level conditions.
- B. Operating Limits: Classify according to AMCA 99, or to Eurovent corresponding classification.

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Specification Sections.
- B. Product Data including rated capacities of each unit with static pressure after recalculation, sound pressure level, weights (shipping, installed, and operating), furnished specialties, accessories, and the following:
 - 1. Material gages and finishes, including color charts.
 - 2. Dampers, including housings, linkages, and operators.
- C. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, location and size of each field connection.
- D. Wiring diagrams detailing wiring for power and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.
- E. Maintenance data for fans to include in the operation and maintenance manual specified in and in Section "Basic Mechanical Requirements."

1.4 QUALITY ASSURANCE

- A. Electrical Component Standard: Provide components that comply with NFPA 70 and that are listed and labeled by UL where available, or as per NF 15100 and NF P 50-411-2.

1.5 COORDINATION AND SCHEDULING

- A. Coordinate the size and location of concrete housekeeping pads. Cast anchor-bolt inserts into pad. Concrete reinforcement and formwork requirements are specified.

- B. Coordinate the installation of roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in corresponding Sections.

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. Centrifugal fans:
 - a. Greenheck
 - b. Barry blower
 - c. Systemair
 - 2. Centrifugal in-line:
 - a. Systemair
 - b. Vent-Axia.
 - c. Woods.

2.2 CENTRIFUGAL FANS

- A. Factory fabricated and assembled (including housing), factory tested, and factory finished, with indicated capacities and characteristics.
- B. Description: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.

2.3 HOUSINGS

- A. Materials and Fabrication: Factory prefabricated, Formed- and reinforced- galvanized steel panels to make curved scroll housings with shaped cutoff, spun-metal inlet bell, and doors or panels to allow access to internal parts and components.
 - 1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 - 2. Fabrication Class: AMCA 99 Class II.
 - 3. Horizontal Flanged Split Housing: Bolted construction.
 - 4. Tubular Centrifugal Fans: Fabricate tubular housing from formed- and reinforced-steel panels with welded seams and the following:
 - a. Outlet guide vanes.
 - b. Spun inlet cone with flange.
 - c. Outlet flange.
 - d. Brackets suitable for horizontal or vertical mounting.
- B. Rooftop fan housing:
 - 1. Penthouse hood type of heavy gage extruded aluminum louvers with mitered and welded corners, with bird screen.
 - 2. Removable hinged aluminum cover for quick access.
 - 3. Prefabricated roof curbs

2.4 WHEELS

- A. Forward/Backward Curved as indicated in the schedule: galvanized steel construction with inlet flange, back plate, shallow blades with inlet and tip curved forward in direction of airflow,

mechanically secured to flange and back plate; cast-steel hub swaged to back plate and fastened to shaft with set screws.

- B. Airfoil Wheel: Steel construction with smooth curved inlet flange; heavy back plate; hollow die-formed airfoil-shaped blades continuously welded at tip flange and back plate; cast-iron or cast-steel hub riveted to back plate and fastened to shaft with set screws.

2.5 SHAFTS

- A. Statically and dynamically balanced and selected for continuous operation at the maximum rated fan speed and motor horsepower (HP), with final alignment and belt adjustment made after installation.
- B. Turned, ground, and polished hot-rolled steel with keyway. Ship with a protective coating of lubricating oil.
- C. Designed to operate so that the first critical speed is at least 25% over the maximum operating speed for each pressure class.

2.6 BEARINGS

- A. Prelubricated and Sealed Shaft Bearings: Self-aligning, pillow- block-type ball bearings.
 - 1. Ball-Bearing Rated Life: AFBMA 9, L-10 of 50,000 hours for staircase pressurization fans and L-50 of 200,000 hours for other.
 - 2. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block type; tapered roller bearings.

2.7 BELT DRIVES

- A. Description: Factory mounted, with final alignment and belt adjustment made after installation.
 - 1. Service Factor Based on Fan Motor: 1.5.
- B. Fan Pulleys: Cast iron or cast steel with split, tapered bushing, dynamically balanced at factory.
- C. Motor Pulleys: Adjustable pitch for use with motors through 5 HP; fixed pitch for use with motors larger than 5 HP. Select pulley so pitch adjustment is at the middle of the adjustment range at fan design conditions.
- D. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
 - 1. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements; 2.7-mm-thick, 20-mm diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
- E. Motor Mount: Adjustable for belt tensioning.

2.8 ACCESSORIES

- A. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
- B. Companion Flanges: Galvanized steel, for duct connections.
- C. Fixed Inlet Vanes: Steel, with fixed cantilevered vanes welded to inlet bell.
- D. Discharge Dampers: Heavy-duty steel assembly with blades constructed of 2 plates formed around and welded to shaft, channel frame, sealed ball bearings, with blades linked out of air stream to single control lever.

1. Configuration: Opposed blade.
- E. Inlet Screens: Galvanized steel welded grid screen, mounted inside shaft bearings.
- F. Scroll Drain Connection: DN25 steel pipe coupling welded to low point of fan scroll.
- G. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
- H. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
- I. Weather Cover: Heavy-gage steel sheet with ventilation slots, bolted to housing.

2.9 MOTORS

- A. Refer to Section "Motors" for general requirements for factory-installed motors.
- B. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B, or as per NF 15 100 class F insulation, IP W 55.
- C. Enclosure Type: The following features are required as indicated:
 1. Guarded drip proof motors.
- D. Select motor as non-overloading over the entire fan curve.
- E. Hood Fans: Motors with 400deg C for 2 hours rating.

2.10 FACTORY FINISHES

- A. Sheet Metal Parts: Enamel or prime coat before assembly. Do not prime coat aluminum parts.
- B. Factory Finish for Fans Downstream from Humidifiers: Enamel or prime coat before assembly with 2 coats of paint. Prime coating on aluminum parts is not required.

2.11 SOURCE QUALITY CONTROL

- A. Testing Requirements: The following factory tests are required as indicated:
 1. Sound Power Level Ratings: Comply with NF E51-705 ,ISO 12499, or,AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans. Or as per the European Standards EN.
 2. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210.

2.12 CENTRIFUGAL IN-LINE FANS

- A. Compact size low noise multi-speed fans.
- B. Casings:
 1. For DN200 and smaller: Fire retardant Polyamide glass-fibre impregnated material.
 2. For larger than DN200: Galvanized sheet steel with built-in guide vanes and drilled flanges.
- C. Impeller:
 1. For DN200 and smaller : Plastic incorporating metal black plates.
 2. For larger than DN200: Galvanized sheet steel.

- D. Motors:
 - 1. Non-overloaded with built-in thermal overload protection.
 - 2. Factory tested with the impeller/casing assembly. .
 - 3. IP44 class B insulation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the fans. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fans according to manufacturer's written instructions.
- B. Support units using the vibration-control devices indicated. Vibration-control devices are specified in Section "Vibration Control."
 - 1. Support floor-mounted units on concrete housekeeping bases using housed spring isolators. Secure units to anchor bolts installed in concrete housekeeping base.
- C. Suspend units from structural steel support frame using threaded steel rods and vibration isolation springs. Vibration-control devices are specified in Section "Vibration Control."
- D. Install units with clearances for service and maintenance.
- E. Label fans according to requirements specified in Section "Mechanical Identification."

3.3 HOUSEKEEPING BASES

- A. Construct concrete housekeeping pads as follows:
 - 1. Coordinate size of housekeeping bases with actual unit sizes provided. Construct base 100 mm larger, in both directions, than the overall dimensions of the supported unit.
 - 2. Form concrete pads with framing lumber with form-release compounds. Chamfer top edge and corners of pad.
 - 3. Install reinforcing bars, tied to frame, and place anchor bolts and sleeves to facilitate securing units.
 - 4. Place concrete and allow to cure before installing units. Use portland cement conforming to ASTM C 150, 27 MPa compressive strength, and normal-weight aggregate.
 - 5. Clean exposed steel form according to SSPC Surface Preparation Specifications SP 2 or SP 3 and apply 2 coats of rust-preventive metal primer.

3.4 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Sections. Drawings indicate the general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.
- B. Electrical: Conform to applicable requirements in Division 16 Sections.
- C. Grounding: Ground equipment. Tighten electrical connectors and terminals, including grounding connections, 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.

3.5 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Lubricate bearings.

3.6 CLEANING

- A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.
- B. Clean fan interiors to remove foreign material and construction debris. Vacuum clean fan wheel and cabinet.

3.7 COMMISSIONING

- A. Final Checks before Startup: Perform the following operations and checks before startup:
 - 1. Verify that shipping, blocking, and bracing are removed.
 - 2. Verify that unit is secure on mountings and supporting devices and that connections for piping, ducts, and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnects.
 - 3. Perform cleaning and adjusting specified in this Section.
 - 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearings operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 5. Verify lubrication for bearings and other moving parts.
 - 6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in the fully open position.
- B. Starting procedures for fans are as follows:
 - 1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
 - 2. Measure and record motor voltage and amperage.
- C. Site engineer to prepare a complete schedule for his reception with complete information about the test he performed for the response of each fan to the requested test; complete air test on flow and velocity, noise level, amperage for running and inrush current.
- D. Replace fan and motor pulleys as required to achieve design conditions.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
- B. Review data in the operation and maintenance manuals. Refer to Section "Contract Closeout."
- C. Schedule training with Owner, through Architect, with at least 7 days' advance notice.
- D. Demonstrate operation of fans. Conduct walking tour of the Project. Briefly identify location and describe function, operation, and maintenance of each fan.

SECTION 15855 - DIFFUSERS, REGISTERS, AND GRILLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.
- B. Related Sections include the following:
 - 1. "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.
 - 2. "Testing, Adjusting, and Balancing" for balancing diffusers, registers, and grilles.

1.2 DEFINITIONS

- A. Diffuser: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
- B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling, or floor.
- C. Register: A combination grille and damper assembly over an air opening.

1.3 SUBMITTALS

- A. Product Data: For each model indicated, include the following:
 - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
 - 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
 - 3. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.
- B. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.
- C. Samples for Verification: Of diffusers, registers, and grilles, in manufacturer's standard sizes, showing the full range of colors. Prepare Samples from the same material to be used for the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Diffusers, registers, and grilles are scheduled on Drawings.
Approved manufacturers:
UIC
KBE
Air Master
Trox

2.2 DIFFUSERS

- A. Square diffuser(supply and return):
 - 1. Material: Aluminum.
 - 2. Finish: Baked enamel, color approved by The Engineer .
 - 3. Maximum Noise-Criterion Rating: 35.
 - 4. Style: Flush mounting.
 - 5. Pattern: 4-way. Square diffuser(supply and return)
 - 6. Damper(for supply only): opposed blade .
 - 7. Fixing : Screwed in the neck.

- B. Round diffuser (supply and return) :
 - 1. Material : Aluminium
 - 2. Finish : Baked enamel, color approved by The Engineer .
 - 3. Maximum Noise-Criterion Rating: 35.
 - 4. Style: Flush mounting.
 - 5. Pattern: radial discharge.
 - 6. Damper (for supply only): flap .
 - 7. Fixing : Screwed in the neck.

- C. Exhaust Round diffuser (for toilets) :
 - 1. Material : UPVC.
 - 2. Finish : color approved by The Engineer .
 - 3. Maximum Noise-Criterion Rating: 40.
 - 4. Style: Flush mounting.
 - 5. Damper: Disk valve with threaded spindle .
 - 6. Fixing : Screwed in the neck.

2.3 REGISTERS AND GRILLES

- A. Registers:
 - 1. Material: Aluminum.
 - 2. Finish: Baked enamel, color approved by The Engineer.
 - 3. Face Blade Arrangement: Adjustable horizontal.
 - 4. Rear Blade Arrangement: Adjustable vertical.
 - 5. Frame: 1 inch (25 mm) wide.
 - 6. Fixing : Countersunk screw.
 - 7. Damper Type: Adjustable opposed-blade assembly.

- B. Exhaust Grilles:
 - 1. Material: Aluminum.
 - 2. Finish: Anodized aluminium in parkings and mechanical rooms .Baked enamel, in decorative areas.
 - 3. Face Blade Arrangement: Fixed horizontal.
 - 4. Frame: 1 inch (25 mm) wide.
 - 5. Fixing : Countersunk screw.

2.4 SOURCE QUALITY CONTROL

- A. Testing: Test performance according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, Coordination Drawings, original design, and referenced standards.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.4 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.