413.7MPa (40,000 psi)] for 16 mm diameter and larger all in accordance with ASTM A615/PNS49.

EXECUTION

1. No unit having a film of water on its surface shall be laid. Masonry shall be laid plumb, true to line, with level courses accurately spaced. Bond pattern shall be kept plumb throughout. Corners and reveals shall be plumb and true. Vertical joints shall be shoved tight. Each unit shall be adjusted to final position while mortar is still soft and plastic. Any unit that is disturbed after mortar has stiffened shall be removed and relaid with fresh mortar. Courses shall be so spaced that backing masonry will level off, flush with the face work at all joints where ties occur. Chases and rake-out joints shall be kept free from mortar or other debris.

2. Anchorage to concrete. Anchorage to abutting columns shall be provided only where indicated. Details shall be as indicated including anchorage to underside of beams and slabs. Cutting and fitting, including that required to accommodate the work of others shall be done by masonry mechanics. Wherever possible, full units of the proper size shall be used in lieu of cut units. Cut edges shall be clean, true and sharp. Openings shall be carefully cut, formed or otherwise neatly made for recessed items and for electrical, plumbing, or other mechanical installations so that wall plates, cover plates, or escutcheons required by the installation will completely conceal the openings and will have bottoms in alignment with lower edge of masonry joints. Webs of hollow masonry units shall be cut to the minimum required for the installation. Reinforced masonry lintels shall be provided as indicated above openings over 300mm wide, for pipes, ducts and cable trays, unless steel sleeves are used.

3. Embedded Items: Spaces around built-in items shall be filled with mortar. Openings around flush-mounted electrical outlet boxes in wet locations shall be pointed flush with mortar including flush joints above the boxes. Anchors, ties, accessories, flashing, pipe sleeves and other items required to be built-in shall be built-in as the masonry work progresses. Anchors, ties, and joint reinforcement shall be fully embedded in mortar.

4. Unfinished work shall be stepped back for jointing with new work. Toothing may be resorted to only when specifically approved. Before laying new work, loose mortar shall be removed and the exposed joint shall be thoroughly cleaned.

5. Mortar: Materials shall be accurately measured in laboratory-established proportions and mixed with as much water as may be necessary to produce the wettest workable consistency possible. Mortar shall be placed in final position within one hour after mixing. Mortar not used or that has started to set within this time interval shall be discarded.

6. Jointing: Joints in exposed-to-view except control joints, joints to be pointed or caulked or sealed, and openings around flush-mounted electrical outlet boxes in wet locations shall be tooled slightly concave with the mortar thoroughly compacted and pressed against the edges of the units. Tooling shall be done when the mortar has been thumbprint hard. The tooled joint shall be finished to uniformly straight and true lines and surfaces, smooth and free of tool marks.
7. Placing Reinforcing Steel
   Prior to placing grout, all reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout or other coating which might destroy or reduce its bond with grout. Details of reinforcement shall be as indicated in the drawings. Reinforcing shall not be bent or straightened in a manner injurious to the steel. Bars with kinks or bends not shown on the drawings shall not be used. Placement of reinforcement shall be inspected and approved prior to placing grout. One piece vertical bars extending from floor to floor or roof above shall be provided. Vertical bars shall be spliced only where indicated.
   (a) Positioning Bars
   Vertical bars shall be positioned accurately at the centerline of the wall. A minimum clearance between the bars and masonry units of 12mm and between parallel bars of one diameter of the reinforcement shall be maintained. Vertical reinforcing shall be held in place using metal supports, centering clips, spacers, ties or caging devices located near the ends of each bar and at intermediate intervals of not more than 192
   diameters of the reinforcement.
   (b) Splices
   Splices shall be located only as indicated. Splices shall be staggered in
   adjacent bars at least 600 mm. Bars shall be lapped a minimum of 40
   diameters of the reinforcement.

ITEM 09 : STEEL AND METAL WORKS

SCOPE OF WORK

The work includes the furnishing of all labor, materials, equipment and other incidentals necessary for the fabrication and installation of structural steel and miscellaneous metal works as specified in relevant items of these specifications and as indicated on the drawings.

SUBMITTAL

(a) Before placing orders for materials for the steel and metal works, the Contractor shall submit to the Engineer for approval shop drawings for all steelwork. All project shop drawings shall show the dimension of all parts, method of construction, bolts, welding sectional areas and other details.

(b) The detail of connections shown on the shop drawings shall be such as to minimize formation of pockets to hold condensation, water or dirt. A minimum gap between abutting angles and the like shall be provided wherever possible to eliminate any traps and facilitate maintenance painting.

(c) No materials shall be ordered nor fabrication commenced until the shop drawings are approved by the Engineer.

(d) Prepare samples of each type of metal handrails & railings stainless steel hairline finish and automotive paint finish as required on GIP metal. Where finish involves normal color and texture variations, include sample sets composed of two or more units showing limits of such variations expected in completed works.

  (i) Include 6" long samples of each distinctly different railing member including handrails, top rails and posts. Include samples of fittings and brackets if requested by Architect.

  (ii) Include sample of typical welded connection.

STORAGE OF MATERIALS

Structural materials, either plain or fabricated, shall be stored above the ground upon platforms, skids, or other supports. Materials shall be kept free from dirt, grease, and other foreign matter and shall be protected from corrosion.

MATERIAL REQUIREMENTS

(a) Unless specified herein all steel structures and metals shall conform with the requirements of Section 3.8, "Steel and Metal Works." Connections where details are not specified or indicated herein, shall be designed in accordance with the American Institute of Steel Construction (AISC), Manual of Steel Construction, latest edition.

(b) Structural steel works consisting of channels, gusset plates and other structural steel shape shall be as indicated on the drawings and shall be structural carbon steel conforming to ASTM A 36. Shapes shall be as given in AISC, Manual of Steel Construction.

(c) Purlins shall be light gage steel tubing conforming to ASTM A 500.

(d) All anchor bolts shall conform to ASTM A 325.

(e) All bolts and threaded fasteners shall conform to ASTM A 307 Carbon Steel Externally Threaded Standard Fasteners.

(f) Tubular stainless steel handrail, rail and post shall either be conform to ASTM A554, Type 316 with diameter and galvanized iron pipe. Refer to the drawings for the type of handrail/railing.

(g) Electrodes for arc welding shall be in accordance with the American Welding Society Code AWS D1.1 unless indicated otherwise. Welding electrodes shall be E70xx.

(h) Fastenings: commercial types, except where special types are shown or required. Fastenings for all exterior work shall be non-ferrous, unless otherwise shown. Fastenings for steel and aluminum and for all other interior work, where exposed, shall match the fastened metal.

(i) Miscellaneous: miscellaneous materials or accessories not listed above shall be provided as specified hereinafter the various items of work and/or indicated on the drawings, or in accordance with manufacturer's specifications.

(j) Contractor shall furnish all plates, cup angles, connectors, etc. required for completion of the structure even if every such item is not shown on the drawings.

(k) Tests are required under the ASTM Standards for steel to be used in the Works and shall be carried out in the presence of the Engineer and at least four (4) days notice must be given to him of the dates proposed for such tests. Four (4) calendar days notice on which fabricated steelwork will be ready for inspection in the Contractor's yard.]

EXECUTION

1. Workmanship
   Fabrication shall be performed within the permissible tolerance by the approved fabricator. All workmanship shall be of the best quality with respect to internationally recognized standards of practice.

2. Cutting
   Low-carbon structural steel may be cut by machine-guided torch instead of by shears or saw.
   Harmful notches, burrs, irregularities, etc., shall not be developed at the cut surface.

3. Contact Faces
   Contact surfaces between bases or other elements bearing directly upon
   bearing plates shall be ground or milled as necessary for full effective bearing.

   Edges for welding shall likewise be properly prepared.

4. Bolt Holes
   Bolt holes shall be according to engineering practice and as specified in these specifications.

   Gas burning of holes will not be permitted.

5. High Strength Bolt Assembly Preparation
   Surfaces of high strength bolted parts in contact with bolt heads and nuts shall not have a slope of more than 1:20 with respect to a plane normal to the bolt axis.
   Where the surface of a high strength bolted part has a slope of more than 1:20, a beveled washer shall be used to compensate for lack of parallelism.
   High strength bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials.
   When assembled, all joint surfaces including those adjacent to washers shall be free of scale except tight mill scale, and shall be free from dirt, loose scale, burrs, and other defects that would prevent solid seating of parts.
   Contact surfaces of friction-type joints shall be free from oil, paint, lacquer or galvanizing.

6. Welding

All welding shall be done only by welders certified as to their ability to perform in accordance with accepted testing requirement.

Welding of parts shall be in accordance with structural standards and the Standard Code for Arc and Gas Welding in Building Construction of AWS, and shall only be done where shown, specified, or permitted by the Engineer.

Damage to galvanized areas by welding shall be thoroughly cleaned with wire brushing and all traces of welding flux and loose or cracked zinc coating shall be removed prior to painting. The cleaned area shall be painted with two coats of zinc oxide-zinc dust paint. The paint shall be properly compounded with a suitable vehicle in the ratio of one part zinc oxide to four parts zinc dust by weight. As an alternative to the above, the Contractor may submit for approval the use of a galvanizing rod or galvanizing solder to repair damaged areas.

The welding machine shall be a stable welder, and have suitable functions for the dimension of materials to be welded. The auxiliary tools used for welding shall perform sufficiently and adequately.

The welding machine used for field welding shall be of readily adjustable for electric current.

7. Shop Assembly

Structural units furnished shall be assembled in the shop.

An inspection shall be made to determine that the fabrication and the matching of the component parts are correct.

Jigs shall be used for the assembly of units as much as possible to maintain appropriate position of mutual materials.

Approval of the Engineer shall be required when drilling temporary bolt holes or welding temporary support to the assembled structure.

The tolerances shall not exceed those allowed by codes and each unit assembled shall be closely checked to insure that all necessary clearances have been provided and that binding does not occur in any moving part.

In order to maintain accurate finished dimensions and shape, appropriate reverse strain or restraint shall be provided as required.

Assembly and disassembly work shall be performed in the presence of the

Engineer, unless waived in writing by the Engineer any errors or defects disclosed shall be immediately remedied by the Contractor.

Before disassembly for shipment, component parts of the structures shall be match marked to facilitate erection in the field.

8. Prerequisite Condition

Prior to executing steel fabrication and field installation, the Contractor shall prepare a comprehensive installation program including engineering supervision organization, fabrication procedures, field installation procedures, material application, machinery applications, inspection procedure, scope and standard of quality judgment, and submit to the Engineer for approval.
Special technical engineering different from contract specifications can be applied upon receiving approval of the Engineer.

9. Installation Requirement
    a. Setting of Anchor Bolt and Others
        1. Anchor bolts shall be set in accurate position by using templates.
        2. The setting method shall be proposed to the Engineer for his approval before setting starts.
        3. The threads of bolt shall be cured with an appropriate method against rust and/or any damage before tightening.
        4. Non-shrink mortar shall be placed under base plates, well cured to obtain the sufficient strength before bearing loads are applied to base plates.
    b. Temporary Bracing
        1. Temporary bracing shall be installed as necessary to stay assemblies and assume loads against forces due to transport, erection operations or other work.
        2. Temporary bracing shall be maintained in place until permanent work is properly connected and other construction installed as necessary for support, bracing or staying of permanent work.
        3. Extent and quality of temporary bracing shall be as necessary against wind and other loads, including seismic loads not less than those for which the permanent structure is designed to resist.

    c. Alignment
        No permanent bolting or welding shall be done until the alignment of all parts with respect to each other shall be true within the respective tolerances required.

ITEM 10 : ROOFING AND TINSMITHRY

SCOPE OF WORK

The work shall include but not limited to all labor, materials, tools, equipment and incidentals necessary to furnish and install the roofing sheets including fittings, flashing caps, ridge rolls, gutters and construction of concrete eaves and canopy excluding waterproofing, to provide completely sound water tight roof for the buildings as shown on the Drawings and specified herein.

MATERIAL REQUIREMENTS

(a) uPVC Corrugated Roofing

(i) Remove existing PVC roofing and replace with new opaque 3mm thick corrugated roofing materials made from high quality virgin polyvinyl chloride (PVC) resin. The PVC roofing system shall include stainless steel bended materials (gutters) and pre-painted bended materials (ridge rolls and fascia flashing), ridge ventilator and complete with hardware accessories.

(ii) Fasteners and Fixation

1. Use appropriate connectors as recommended by the manufacturer and approved by the Architect. Use the same metal or a metal compatible with the item fastened. Use fasteners to fasten dissimilar materials.
2. Paint same color as roof all exposed fixation and fastening devices. Use tekscrew cap.
3. Apply fasteners in a neat, consistent, even and standard manner. Apply strip of butyl rubber-based caulking compound along all end lap joints and passing over pre-drilled fixation holes.
4. For fixation of flashing. Use tekscrews (Steel) for roof eaves area, where roof frames are exposed.
5. Use tekscrew for all roofing corrugation.

(iii) Gutter shall be 0.60mm stainless steel ASTM A Type 302 or 304, 2D Finish, fully annealed, dead-soft temper.

(iv) Fascia and Flashing shall be pre-painted 0.60mm thick (Gauge 24) base metal.

(b) Polycarbonate Roofing

(i) Solid polycarbonate sheets shall be 6 mm thick with aluminum clamping, rubber gasket, 100's steel tekscrews, silicone sealants, etc., to complete. Ultraviolet (UV) protected on both sides of the sheet.

(ii) Structural Steel frame shall be in accordance with the drawing or manufacturer's standard.
(iii) Fasteners: Provide U connector, end cap connectors and other accessories as per manufacturer's standard.

(c) Fiber Tensile Fabric Canopy
(i) Provide PVC coated polyester fabric with the fire test response characteristics and able to withstand wind load and waterproof.
(ii) Canopy anchorage shall be hot dipped galvanized steel pipe or stainless steel pipe including accessories.

(d) Samples
Samples shall be submitted for Engineer's approval before any order for roofing materials be made by the Contractor.

INSTALLATIONS

(1) uPVC Corrugated Roofing
(i) Lay down the roofing sheet starting from the end opposite the prevailing wind.
(ii) Lay and install the first sheet with the turn down edge towards the outside of the area to be covered.
(iii) Overlay the next sheet in such a manner that the exposed edge is turned down and the covered edge is turned up.
(iv) Side-lap fasteners shall be done by the rivets and washers spaced from 305mm (12") to 457mm (18") on centers.

(2) Polycarbonate Roofing
(i) Install plastic glazing in accordance with polycarbonate sheet manufacturer's instructions.
(ii) Do not use glazing accessories not specified or approved by polycarbonate sheet manufacturer.
(iii) Immediately after cleaning, cover polycarbonate sheet glazing surfaces with polyethylene sheeting, or other covering material approved by polycarbonate sheet manufacturer; secure covering in place by taping to framing members - do not tape covering to polycarbonate sheet materials.

(3) Gutter
The hung type of shape indicated and supported on underside by brackets that permit free thermal movement of the gutter. Provide gutters in sizes indicated complete with mitered corners, end caps, outlets, brackets, and other accessories necessary for installation. Bead with hemmed edge or reinforce the outer edge of gutter with a stiffening bar not less than 20 by 5 mm of material compatible with

gutter. Fabricate gutters in sections not less than 2400 mm. Lap the sections a minimum of 25 mm in the direction of flow or provide with concealed splice plate 150 mm minimum. Join the gutters, other than aluminum, by riveted and soldered joints. Support gutters on adjustable hangers spaced not more than 750 mm on center or as recommended by the manufacturer. Adjust gutters to slope uniformly to outlets, with high point occurring midway between outlets. Fabricate hangers and fastenings from metals compatible with the gutters.

(4) Flashing

(i) Bolts, Rivets, and Screws

Install bolts, rivets, and screws where indicated or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection.

(ii) Seams

Straight and uniform in width and height with no solder showing on the face.

(iii) Edges

Pretin edges of sheet metals before soldering. Slowly solder with well heated soldering irons so as to thoroughly heat the seams and completely sweat the solder through the full width of the seam. Treat with soldering acid flux the edges of stainless steel to be pretinned. Solder immediately after application of the flux. Upon completion of soldering, the acid flux residue shall be thoroughly cleaned from the sheet metal with a solution of washing soda in water and rinsed with clean water.

(iv) Fasteners

Install fasteners at spacing recommended by the Manufacturer.

(v) Cleaning

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

(vi) Repairs to Finish

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

ITEM 11 : TOILET PARTITION

DESCRIPTION

General Requirements contain provisions and requirements essential to these Specifications; and apply to this section, whether or not referred to herein.

SUBMITTALS

1. Submit shop drawings indicating elevations of partitions, full scale sections, thickness and gauges of metal, fastenings, proposed method of anchoring, the size and spacing of anchors, details of construction, hardware, fittings, mountings, and other related items and installation details.
2. Submit sample one of each item of hardware, fittings, fastening, and each type of panel. The panel sample shall be cross-sectioned not less than 150 mm by 150 mm in size and shall show finish on base material and core of the panel.
3. Submit manufacturer's data literature for each item of hardware, fitting, fastening and each type of panel, complete with description of materials, finishes, and anchoring devices, and appurtenances.
4. Submit one sample of each color of partition for verification that products match the color indicated. Where colors are not indicated, submit the manufacturer's standard color samples for selection by the Engineer.

MATERIAL REQUIREMENTS

Toilet compartments/cubicles - comprising 12mm thk intermediate panels, doors, and partitions/compartments (compact laminated phenolic board) including door frame system urinal divider, cubicle divider, hardware and accessories in stainless finish and all other incidentals to complete.

Sizes, dimensions of doors, cubicles and dividers as shown on plans. Color shall be as selected by the Engineer.

All the accessories shall be of heat chemical and bacteria resistant.

All edges of doom and pilasters are chamfered and finish without any metal trimming.

EXECUTION

Installation of toilet partitions and urinal screens shall be in accordance with approved shop drawings and manufacturer's installation and directions.

ITEM 12 : PLUMBING AND SANITARY WORKS

SCOPE OF WORK

The work covered for this section shall consist of furnishing all labor, tools, equipment, materials and incidentals necessary for the complete installation, testing and operation of the plumbing and sanitary system within the buildings and premises in accordance with these Specifications and as shown on the drawings or as directed by the Engineer. The septic tank and their effluent and discharge pipelines shall be part of other section of these specifications.

MATERIAL REQUIREMENTS

SUBMITTAL

1. The Contractor shall submit his work method statement with necessary shop drawings to the Engineer for approval twenty eight (28) days before the start of the works.

   Shop drawings shall be dated and shall contain the name of the project and location of the subject item in the shop drawing which is to be installed.

   The Engineer wiil review and approve or return for correction all shop drawings with reasonable promptness. The Contractor shall make any corrections required and file with the Engineer three (3) corrected copies of the shop drawings.

2. The drawings shall indicate the general arrangement of all pipings, however, where actual conditions necessitate re-arrangement in opinion of the Contractor and/or the Engineer, the Contractor shall prepare and submit to the Engineer for approval, twenty eight (28) days before placing the order for materials, shop drawings of the proposed re-arrangement. Because of the small scale of the drawings, shop drawings to indicate all offsets, fittings and accessories shall be prepared. The Contractor shall carefully examine the drawings and shall carefully investigate actual structural and finish conditions affecting all his work.

3. The Contractor shall be responsible for the proper fitting of materials, equipment and accessories without substantial alteration and at no cost to the Employer.

4. The Contractor shall be responsible for the proper coordination of the work and shall provide all necessary clearance where necessary.

STANDARDS

Use of materials shall further be governed by other requirement imposed on other sections of these Specifications. Materials shall be subject to tests necessary to ascertain their fitness if the Engineer so requires. All works shall comply with the pertinent provisions of the Plumbing Code of the concerned city or town, the Code on Sanitation of the Philippines, and/or the National Plumbing Code of the Philippines.

MATERIALS

1. Identification of Materials

Each length of pipe, fittings, traps, fixtures and devices used in the plumbing work shall have cast, stamped or indelibly marked on it, the approved manufacturer's trademark or name, the weight, type and class of product when so required by the standards mentioned above.

2. Alternative Materials

Use of any material not specified in this Specification may be allowed provided such alternate has been approved by the Engineer and provided further that a test, if required, shall be done by an approved agency in accordance with generally accepted standards.

3. Soil, Waste, Drain, Vent Pipes and Fittings

Soil, waste and vent pipes shall be unplasticized Polyvinyl Chloride (uPVC) pipes. Diameter shall be as indicated on the Drawings. It shall conform to ASTM D 1784 or ASTM D 2729.

Drainage pipes shall be reinforced concrete pipes (RCP), diameter shall be as indicated on the Drawings.

4. Jointing Material

The joint material for uPVC pipes shall be PVC solvent cement as recommended by the approved pipe manufacturer.

5. Water Supply Pipes

Water supply pipes shall be polypropylene random-80 (PPR-80) pipes PN 20 conforming to DIN Standards DIN 1988/DIN 8078, German made. Jointing shall be fusion welded.

6. Clean-outs, Plugs and Tee

Clean-outs shall be of the same material as the pipe to be fitted. Cleanouts installed in connection with uPVC hubs and spigot pipes shall consist of a long sweep quarter bend of 14 as shown on the drawings.

7. Pipe Sleeves

Pipe sleeves shall be installed and property secured in place at all points where pipes passes through masonry or concrete. Pipe sleeves shall be uPVC pipe, Schedule 40.

8. Downspout

All downspout shall be unplasticized polyvinyl chloride (uPVC) pipe class DWV conforming to ASTM D2729 or ASTM D1784 for sanitary pipes, Series 1000.

9. Splash Block

Provide splash blocks at the outlet of downspout emptying at grade which shall be made of precast concrete, with smooth finished counter sunk dishes sloped to drain away from the building. Dimensions as shown on the Drawings.

10. Roof Strainers

The Contractor shall provide fittings and install 100mm G.I. mesh wire strainers where shown or indicated on the drawings and/or where the Engineer directs. Each strainer shall fit the size of the corresponding downspout which is to be installed.

11. Shower, Floor and Urinal Drain

Shower and floor drains shall be made of stainless steel non-tilting grate, perforated or slotted. Urinal drains shall be cast iron dome type drain.

12. Pipe hangers, Inserts and Support

a) Pipe hangers shall be wrought iron, malleable iron pipe hangers spaced not over 1.5meters apart for uPVC pipes and 3.0meters apart for iron pipes. Chain straps, perforated bars or wire hangers will not be permitted.

Hangers shall have short turnbuckles or other approved means of adjustment.Tum buckles may be omitted on hangers where space does not permit their use.Trapeze hangers may be used in lieu of separate hangers for pipes running parallel to each other and close together.

b) Inserts shall be of cast iron or cast steel and shall be of a type to receive a machine bolt head or nut after installation.

c) Wrought iron clamps or collars shall be used to support vertical runs of pipes.

13. Unions

Union pipe 50mm and smaller shall be malleable iron. Union on water piping 63mmØ and larger shall be flanged pattern and shall be of galvanized (zinc coated) cast iron. Gaskets for flange unions shall be of best quality fiber plastic or leather.

14. Valves

Valves shall be cast bronze of brass body. Chrome plated finish for all fixture taps and faucets and natural finish for all others, like hose bibs, gate valves and which are not tapped directly to a plumbing fixture. Concrete valve boxes shall be installed where required and will be of sufficient size for operating the valve.

15. Fixtures

a) Water Closets

All water closets for toilets as shown on the drawings shall be tank type, white with complete fittings and mounting accessories.

b) Lavatories

i. Lavatory (Wall Hung)

Shall be vitreous china, wall hung lavatory with rear overflow holes, fitting ledge suitable for single faucet holes on centers complete with faucet, standard fittings, trap and lavatory brackets and other accessories.

ii. Lavatory (Countertop Lavatory)

Shall be vitreous china, oval or round shaped countertop lavatory with front overflow hole, complete with faucet, supply valve and fittings with P-trap. Fitting ledge suitable for single hole on center.

c) Urinals

i. Urinals for all comfort buildings shall be built-in urinal trough as shown on the drawings.

ii. Urinals shall be vitreous china, wall-hung washout urinal, flushing rim, integral trap, 19mm top and shall be provided with water savingflush system.

d) Service Sinks

Service sinks where indicated or shown on the Drawings shall be stainless steel, with single bowl and with complete U.S. or Japan imported fittings.

e) Slope Sinks

Slop sink shall be 24"x20" acid resisting enamel on Cast-Iron with concealed hanger and faucet.

Hose bib shall be of brass finish.

f) Soap Holder

Soap holder and toilet paper holder shall be vitreous china, wall mounted. All toilet/bath rooms will be provided with soap holder, toilet paper holder and chrome plated towel racks.

g) Faucet for lavatory

Faucet for lavatory shall be in chrome-finish.

h) Bath and shower fitting

Bath and shower fitting shall be chrome-finish.

i) Towel Rail

Towel rail shall be tubular stainless steel, 2.7mmØ, and 0.54m long or as specified in the drawings.

j) Curtain rod

Curtain rod shall be tubular stainless steel, 19mmØ or as specified in the drawings.

k) Grab Bar

Grab bar shall be tubular stainless steel, 25mmØ or as specified in the drawings.

l) Bidet Spray Combination

Installed in every cubicle near on the water closet, colored white or its equivalent

16. Concrete, Reinforcing Steel, Pipe and Steel Plate

Materials for wash pits, catch basins and manholes shall conform to the requirements as follows:

a) Concrete materials shall conform with the requirements in "Concrete Works" and shall be Class C concrete with a 28-day minimum compressive strength of 21 MPa (3,000 psi).

b) Reinforcing steel shall be as shown on the drawings and shall conform with the requirements of reinforcing steel bars in "Concrete Works."

c) Pipes shall be as shown on the drawings and shall comply with the relevant item of the particular pipe.

d) Steel plates shall be as shown on the Drawings and shall comply with Section "Steel and Metal Works".

17. Non-reinforced Concrete Pipe

Non-reinforced concrete pipe shall be as shown on the Drawings and shall conform with the requirements of non-reinforced concrete pipes AIC latest edition. Concrete shall be with a 28-day minimum compressive strength of 20.7 MPa.

18. Valve for Drinking Fountain

Valve where drinking fountain will be connected shall be polished brass pipe and shall have red enameled handle.

EXECUTION

All installation works shall be in conformity with the National Plumbing Code of the Philippines (NPCP).

EXCAVATION, TRENCHES AND BACKFILLING

1. Trenches for ail underground pipelines shall be excavated to the required depth. The bottom of trenches shall be tamped hard and graded to secure the required fill. Bell holes shall be excavated so that pipes will rest on solid ground for their entire length.

   Rocks encountered shall be excavated to a depth of 150mm below the bottom of the pipe and before the pipe is laid, the space between the bottom of the pipe and the rock shall be filled with sand. Sewer and water pipes shall be laid in separate trenches.

2. After pipelines have been tested, inspected and approved by the Engineer and prior to back-filling, all forms shall be removed and the excavation shall be cleaned of all trash and debris.

   Materials for back-filling shall consist of acceptable excavated soil, borrow of sand, gravel or other materials approved by the Engineer and shall be free from trash, lumber or other debris. Back-filling shall be placed in horizontal layers not exceeding 150 mm in thickness and properly moistened to approximate optimum requirements. Each layer shall be compacted by hand or machine tamper or by other suitable equipment to a density that will prevent excessive settlement or shrinkage.

   Backfill shall be brought to a suitable elevation above grade to provide for anticipated settlement and shrinkage thereof.

   Water pipes shall have a sand cushion 150mm below and above the pipes.

INSTALLATION OF SOIL, WASTE DRAINS OR VENT PIPES

1. Horizontal Drainage Pipe and Vent Piping

   Horizontal waste pipes 75mmØ and smaller shall have a minimum grade of 6.5mm per 0.30m and for 100mmØ and larger, 3.2mm per 0.30m. All main vertical soil and waste stacks shall be extended full size above the roof line as vents, except where otherwise specifically shown.

   Where practicable, two (2) or more vent pipes shall be connected together and extended as one pipe through the roof. Vent pipes in roof spaces shall be run as close as possible to the underside of roof with horizontal piping pitched to stacks using fittings as required without forming traps in pipes.

   Vertical pipe vents may be connected to a vent line carrying other fixtures. The connection shall be at least 1.20m above the floor on which the fixtures are located to prevent the use of vent lines as waste. Horizontal waste lines receiving the discharge from two (2) or more fixtures shall be provided with vents, unless separate venting of fixtures is noted.

2. Fittings

   All changes in pipe sizes on soil waste lines shall be made with reducing fittings or recessed reducers. All changes in direction shall be made by the appropriate use of forty five (45) degree wyes. Long sweep quarter bends or elbows may be used in soil and waste lines where the change in direction of flow is from the horizontal to the vertical and on the discharge from water closets.

Where it becomes necessary to use short radius fittings in any location, the approval of the Engineer shall be obtained before they are installed.

3. Joints

   a) PVC Soil Pipe

All joints in uPVC soils, waste and vent pipe shall be accomplished by the use of PVC solvent cement

   b) All joints for uPVC shall be accomplished by applying the manufacturer's recommended solvent before connection to the pipe.

4. Clean-outs

Clean-outs at the bottom of each soil stack, waste stack and where else indicated shall be the same size at the pipe.

Clean-outs on floors shall be by uPVC plug adapter fit into the hub and fitted with uPVC screw plugged flush with the floor.

Clean-out shall be provided at every change in direction greater than 45 degrees.

5. Flashings

All pipes passing through the roof shall be provided with lead flashings. All flashings shall be built to 40 lbs. bituminous felts and shall extend up to the pipe and down-over to top of pipe at least 150mm and along the roof not less than 300mm and shall lap over flashing to make a weatherproof joint.

6. Traps

Each fixture and piece of equipment requiring connections to the drainage system, except fixtures with continuous waste, shall be equipped with a trap. Traps shall be specified to be supplied with the fixtures. Each trap shall be placed as near to the fixtures as possible. Traps installed on threaded pipes shall be a recessed drainage pattern.

7. Pipe Sleeves, Hangers and Supports

Pipe sleeves shall be installed and properly secured in place at all points where pipes pass through masonry or concrete, except unframed floors on earth.

Pipes shall not be permitted to pass through footings or beams unless noted on the drawings.

Pipe sleeves in floors shall extend not less than 25mm and not more than 50mm above the finished floor. After installation of the pipe, the space around the pipe shall be packed with plastic material and made watertight. Flashing shields for sleeves passing through waterproofing membrane shall be thoroughly mopped into the membrane. The space between the pipe and sleeves shall be made watertight by inserting approved sealing and caulking materials.

INSTALLATION OF WATER PIPES, FITTINGS AND CONNECTIONS

1. Gate Valves and Outlets

Gate valves shalt be installed close to the point of connection to the existing service line outside the building. The piping shall be extended to all fixture outlets and equipment from the gate valves. Outlets where indicated shall be capped or plugged and left ready for future connections.

2. Mains, Branches and Run-outs

All runs of piping shall be installed as shown on the drawings. The piping shail be cut accurately to measurements, and installed at the building site by the Contractor and shall be worked into place without springing or forcing. Care shall be taken not to weaken the structural portions of the buildings.

All pipes above ground shall be run parallel with the lines of the building unless otherwise shown on the drawings. Branch pipes from service lines may be taken off on top of mains, bottom of mains or side of mains, using such cross over fittings as may be required by structural or installation conditions.

All service pipes, valves, and fittings shall be kept at a sufficient distance from the other work to permit finished covering not less than 6.5mm from such other work and not less than 13mm between finished coverings on different services. No water piping shall be buried in floors unless specifically indicated on the drawings or approved. Changes in pipe sizes shall be made with reducing fittings. The use of long screws and bushings is prohibited.

3. Joints

Joints and connections in the plumbing system shall be gas-tight and watertight for the pressures required by test.

After cutting and before threading all pipes shall be reamed and shall have burrs removed.

All screwed joints shall be applied with an approved graphite compound or TEFLON tape to facilitate connections. Threads shall be full cut, and not more than three threads on the pipe shall remain exposed.

Caulking of threaded joints or top to prevent leaks shall not be permitted.

Unions shall be provided where required for disconnection. Threaded swing bolts shall be used for branch connections to risers and mains.

4. Unions

Where required, unions shall not be concealed in walls, ceilings or partitions.

5. Tests

The following tests shall be conducted by the Contractor at his expense under the supervision of the Engineer.

a) Tests for Drainage and Venting System

The entire drainage and venting system shall have necessary openings plugged to permit the entire system to be filled with water to the level of the highest vent stack above the roof. The system shall hold the water for 30 minutes with a drop not greater than 100mm.

b) Sterilization

The entire water supply piping system shall be sterilized with a solution containing not less than fifty (50) parts per million of available chlorine, either liquid chlorine or a solution of sodium hypochlorite. The sterilizing solution shall remain in the system for a period of not less than 8 hours, during which time all valves and faucets shall be opened and closed several times. After sterilization, the solution shall be flushed from the system with clean water until the residual chloride content is not more than 0.2 parts per million.

c) Pressure Test for Water Lines

1. After the pipe have been installed, the joints completed and with joints exposed for examination, all newly installed pipe or any valve section, thereof, shall be subjected to hydrostatic pressure one and one half (11/2) the designed working pressure of the system or as specified by the Engineer.

2. The duration of each pressure test shall be at least 20 minutes unless otherwise specified by the Engineer.

3. Each section of pipeline shall be slowly filled with water and the specified test pressure, measured at the point of lowest elevation, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. During the filling of the pipe and before applying the test pressure, all air shall be expelled from the

pipeline. To accomplish this, tap shall be made if necessary, at the highest point of the pipe under test and after completion of the test, the taps shall be tightly plugged unless otherwise specified. During the test, all exposed pipes, fittings, valves, joint and couplings will be carefully examined. If found to be cracked or defective, they shall be removed and replaced by the Contractor with sound materials at his expense. The test shall then be repeated until satisfactory results are obtained.

d) Leakage Test for Water Lines

1. Leakage test shall be conducted after satisfactory completion of the pressure test and shall consist of an examination of all exposed joints for leakage as well as an overall leakage test of the completed pipeline.

2. The pressure to be maintained during the test shall be the designed working pressure of the system.

3. Leakage test shall be made only after a minimum of 24 hours after the pipe to be tested has been filled with water.

4. The duration of each leakage test shall be two hours unless otherwise specified by the Engineer.

5. Each section of pipeline shall be slowly filled with water and the specified test pressure, measured at the point of lowest elevation shall be applied by means of a positive displacement type pump and reservoir connected to the pipe in a manner satisfactory to the Engineer.

6. Before Starting the leakage test, all air shall be expelled from the pipe. All exposed pipes, fittings, valves and joints shall be examined for leakage during the test.

e) Defective Work

1. If the inspection or test shows any defect, such defective work or material shall be replaced and the test shall be repeated until satisfactory to the Engineer.

2. All repairs to piping shall be made with new materials at the expense of the Contractor.

3. No caulking of screwed joints or holes will be accepted.

ASSEMBLY, INSTALLATION, AND CONNECTION OF FIXTURES

Fixtures shall be supported and fastened in a satisfactory manner. Where secured to concrete or masonry work walls, fixtures and equipment shall be fastened with brass bolts or machine screws in lead-sleeve type anchorage units or with brass expansion bolts. Expansion bolts shall enter 7.5 cm into solid concrete or masonry works and shall be fitted with loose tubing or sleeves of proper length to bring expansion sleeves into the solid concrete masonry walls.

Where wood screws are used, screws shall go into solid pieces set between studs. Where through-bolts are used, bolts shall be provided with plates or washers at back set, so that they will be concealed by plaster. Bolts and nuts shall be hexagonal and exposed nuts, cap nuts, and screw heads shall be provided with chromium plated brass washers.

PROTECTION OF FIXTURES

Pipe openings shall be closed with caps or plugs during installation. Fixtures shall be tightly covered and protected against dirt, water and chemical injury. At the completion of all works, all fixtures shall be thoroughly cleaned and delivered in a condition satisfactory to the Engineer.

FIXTURES AND FASTENING

All fixtures shall be supported and fastened in a satisfactory manner as follows:

1. Where secured to concrete or concrete hollow block walls, they shall be fastened with one quarter inch brass bolts with twenty threads to the inch and of sufficient length to extend at least 7.5 cm into solid concrete or hollow block work, fitted with loose tubing or sleeve insert and shall be securely anchored and installed flush with the finished wall and shall be completely concealed when the fixtures are installed.

2. Where through-bolts are used, they shall be provided with plates or washers back set so that heads, nuts, and washers will be concealed by plaster. Bolts and nuts shall be hexagonal. Exposed bolts, nuts, cap nuts, and screw heads shall be provided with chromium-plated brass washers.

GUARANTEE

Upon completion and before final acceptance of the equipment installation, the Contractor shall furnish the Engineer a written guarantee stating that all equipment installed under this Section is free from defects. The guarantee shall be for a period of one (1) year from the date of final acceptance of the work. Any part of the equipment that becomes defective during the term of the guarantee shall be replaced, renewed, and/or made good by the Contractor, at his own expense and in a manner satisfactory to the Engineer.

Guarantees made by the approved manufacturers or suppliers beyond one year, shall be transferred to PPA without any expense on his part.

CLEANING UP

Upon completion of the work, all parts of the installation shall be thoroughly cleaned of grease, metal cuttings and sludge which may have accumulated during the testing operation.

PLUMBING, FIXTURES AND TOILET ACCESSORIES INSTALLATION

All installation works shall be as shown on the drawings and shall conform to the applicable standards set forth by the Philippine National Plumbing Code. All fixtures shall be fastened and/or supported in accordance with the given requirements.

ITEM 13 : DRAINAGE WORKS

SCOPE OF WORK

The works shall consist of excavation, back-filling and construction of lateral drains, construction of manholes, reconnection to existing lateral and other related works in accordance with the dimensions, size, elevation and grade as shown on the drawing and shall conform with the Specification.

At least thirty (30) days before the start of any construction related to drainage works, the Contractor shall submit to the Engineer for his approval, shop drawings of the drainage work he intends to construct. The shop drawings shall include the materials and the general method of installation he intends to employ.

MATERIAL REQUIREMENTS

SELECTED FILL

Fill shall be in accordance with Item "Reclamation and Fill".

CRUSHED AGGREGATE BASE COURSE

Gravel base course shall be in accordance with Item "Crushed Aggregate Base Course".

SAND BEDDING

Sand bedding shall be in accordance with Item "Reinforced Concrete (Fine Aggregates)".

CONCRETE

Mixing/Casting and steel reinforcements shall be in accordance with Item "Reinforced Concrete" while the dimensions shall be as shown on the Drawings.

CEMENT MORTAR

Cement mortar shall consist of one part portland cement to two parts of fine aggregate with water added as necessary to obtain the required consistency.

REINFORCED CONCRETE PIPE

The fabrication of reinforced concrete pipes shall conform to the Specifications of ASTM C 76 while the testing requirements shall conform to ASTM C 497. The Engineer reserves the right to inspect and test the pipe delivered for intended purpose. Defects that are discovered after acceptance of delivery of the pipe but before installation shall be a cause for rejection.

Reinforced steel bar for pipe shall be in accordance with Item "Reinforced Concrete" while concrete to be used shall be 4,000 psi.

EXECUTION

EARTHWORKS

All earthworks for concrete pipe culvert shall conform to the lines, grades and elevations shown on the drawings or as directed by the Engineer.

The lateral drain shall be excavated to the depth, grade and width established by the Engineer. The bedding surface shall provide a firm foundation of uniform density throughout the entire length. Soft,

spongy, or otherwise unstable material encountered that will not provide a firm foundation for the concrete drainage shall be removed to the full width of the trenches and replaced by suitable material to a depth of not less than 30 cm. 100mm thick gravel bedding shall be used as foundation or otherwise as specified.

PIPE LAYING

The pipe shall be tested for water-tightness of joints before back-filling the trench. Unsatisfactory work shall be corrected without additional cost to the PPA. The collar shall have set sufficiently prior to back-filling.

LATERAL DRAIN

Concrete cover and the existing steel gratings shall be set to the required elevations as shown on the drawings to fit the adjoining surfaces and shall be installed after the adjoining concrete is struck off and finished, and the fit on the frames shall be such that there is no rocking.

All completed structures shall be thoroughly cleaned of any accumulations of silts, debris or foreign matter of any kind, until finally accepted and put into service.

CATCH BASIN INLETS, MANHOLES AND OUTLETS

Lid frames shall be set to the required elevations as shown on the drawings to fit the adjoining surfaces. Lids shall be installed after the adjoining concrete is struck off and finished, and the fit on the frames shall be such that there is no rocking.

Where reconstruction of existing catch basin inlets, manholes, outlets, or similar structures is indicated, the work shall be in accordance with the details and elevations as shown on the drawings, including re-installation of existing metal frames, grates, and lids, or replacement of concrete covers instead of grates that may have been lost or found lacking. All completed structures shall be thoroughly cleaned of any accumulations of silts, debris, or foreign matter of any kind until finally accepted and put into service.

FIELD DENSITY TEST

Field Density tests to determine the percent of compaction of the fill material shall be conducted until a field density of at least 95 percent of the maximum dry density in accordance with AASHTO T180, Method D has been achieved. In place density determination shall be made in accordance with AASHTO T191.

ITEM 14 : ELECTRICAL WORKS

GENERAL

"Electrical General Requirements," applies to this section with additions and modifications specified herein.

WORK INCLUDED

The work to be done under this division shall include the furnishing of all tools, labor, supervision, equipment, fixtures and all necessary materials, each complete and in proper working condition unless one or other is specifically excluded or stated otherwise in this specifications but not limited to the following items of works.

a. All works and material for a complete lighting and power systems including cables and conduits, circuit breakers, panel board and connection to all lighting fixtures and power outlets, motor appliances, switches, supports and accessories.

b. All excavation works, back-filling, dewatering, removal of surplus earth, preparation of formworks and pouring of concrete envelopes as indicated on the drawings or as required to complete the installation.

c. All steel support for conduits, wires, panel board, boxes, lighting fixtures, etc. as indicated or as required to complete the installation.

d. A complete grounding system as required by the governing codes.

e. A complete testing of all electrical systems.

f. All items incidentals to and or required for the proper completion such as painting of boxes, conduits and the likes.

g. Coordination with other trade Contractors.

h. Coordination with other companies/offices including handling of all materials related to material testing and application of electrical permits.

Preparation of necessary shop drawings required for the proper execution of the works subject to the approval of the Engineer.

SUBMITTALS

1. Shop Drawings

    a. Panel board

2. Manufacturer's data

a. Circuit breakers

b. Switches

c. Conduit and fittings (each type)

d. Outlet and junction boxes

3. Test Reports: Submit test results for approval in report form.

a. Devices Subject to Manual Operation

4. Quality Assurance

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" has been substituted for 'should' wherever it appears. Interpret reference in these standards to "authority having jurisdiction," or words of similar meaning, to mean Engineer.

MATERIALS AND EQUIPMENT REQUIREMENTS

Materials, equipment, and devices shall, as minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70. All items shall be new.

CONDUIT AND FITTINGS

1. Rigid Steel Conduit (RSC): Hot dip galvanized; ANSI C80.1.

2. Flexible Metal Conduit: UL 1.

a. Liquid Tight Flexible Metal Conduit (Steel): UL 360.

3. Rigid Plastic Conduit: PVC schedule 40 in accordance with UL 651.

4. Fittings for Metal Conduit, and Flexible Metal Conduit; UL 5146.

Ferrous fittings shall be hot dip galvanized in accordance with UL 514.

a. Fittings for RSC: Shall be threaded-type. Split couplings are not acceptable.
b. Fittings for Rigid Non-metallic Conduit: NEMA TC3.

OUTLET BOXES AND COVERS

UL 514, hot dip galvanized for ferrous metal.

CABINETS, JUNCTION BOXES. AND PULL BOXES (WITH VOLUME GREATER THAN 100 CUBIC INCHES) UL 50, hot dip.

WIRES AND CABLES

Wires and cables shall meet applicable requirements of PEC. NFPA 70 and UL for types of insulation, jackets, and conductors specified or indicated. Wires and cables manufactured more than 6 months prior to date of delivery to site shall not be used.

1. Conductors; Conductor 3.5mm2 and smaller shall be solid, 5.5mm2 and larger shall be stranded. All conductors indicated shall be copper.

    a. Equipment Manufacturer Requirements;

If manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to satisfy manufacturer's requirements.

2. Insulation:

Unless specified for indicated otherwise or required by PEC and NFPA 70, power and lighting wires shall be 600volt.Type THHN / THWN.

3. Bonding Conductors:

ASTM B1, solid bare copper wire for sizes 8.0 mm2 and smaller diameter; ASTM B8, Class B, stranded bare copper wire for sizes 14 mm2 and larger diameter.

DEVICE PLATES

Provide UL listed, one-piece device plates for outlets and fittings to suit the devices installed. For metal outlets and fittings, plates on unfinished avails and on fittings shall be of zinc-coated sheet steel or cast metal having round or bevelled edges. Plates on finished walls shall be urea or phenolic, minimum 2.5mm wall thickness. Plates shall be same color as receptacle or toggle switch with which they are mounted. Screws shall be machine type with countersunk heads in a color to match the finish of the plate. Use of sectional-type device plates mil not be permitted. Plates installed in wet locations shall be gasketed and UL listed for "wet locations."

SWITCHES

1. Switches

Totally enclosed with bodies of thermo setting plastic and mounting strap. Wiring terminals shall be screw-type, side-wired. Switches shall be rated quiet-type AC only, 250 volts, with current rating and number of poles indicated.

WALL SWITCHES AND PLATES

Wall switches in general shall be rated 10 amperes at 230 volts or with ampere and voltage ratings as required. Switches shall be flush mounting and of the rocker type, spring operated. The type of switches shall be tumbler operation and the color, plating and appearance of wall plates shall be as selected by the Engineer. Appropriate samples shall be submitted prior to purchase of wall switches and face plates.

2. Receptacles

UL 498 and NEMA WD 1, heavy duty, grounding type. Ratings and configurations shall be as indicated. Wiring terminals shall be screw type, side-wired. Connect grounding pole to mounting strap.

WALL RECEPTACLE AND PLATES

a. Receptacle outlets shall be 15 ampere, 230 volts, 2 pole, 3 wire parallel slot, grounding type. Parallel slot outlet rated 15 amps. 125v grounded type shall be acceptable for use with 230v system. Locking type and other special purpose outlets shall be as indicted in the plans.

b. Provide weatherproof receptacle plate cover for each convenience receptacle outlet Indicated as weatherproof.

SPECIAL PURPOSE RECEPTACLES:

Receptacles serving as indicated are special purpose. Provide ratings as indicated. Furnish one matching plug with each receptacle.

PANEL BOARD

UL 67 and UL 50. Panel board for use as service disconnecting means shall additionally conform to UL 869. Panel board shall be circuit breaker equipped unless indicated. Design shall be such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL. Where "space only" is Indicated, make provisions for the future installation of a breaker sized as indicated. Panel board locks shall be keyed same. Directories shall be typed to indicate load served by each circuit and mounted in a header behind transparent protective covering.

1. Panel board Buses

All buses shall be copper support bus bars on bases independent of circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tailing. Provide a separate ground bus per UL 67 for connecting grounding conductors; bond to steel cabinet.

2. Circuit Breakers (Bolt-On)

Ambient-compensated thermal magnetic-type solid state-type with interrupting capacity of 10,000 amperes symmetrical minimum. Breaker terminals shall be UL listed as suitable for the type of conductor provided. Plugin circuit breakers are unacceptable.

a. Multi-Pole Breakers

Provide common trip-type multi-pole breakers with single operating handle. Breaker design shall be such that an overload in one pole automatically causes all poles to open.

ENCLOSED CIRCUIT BREAKERS

UL 489. Individual molded case circuit breakers with voltage and continuous current ratings, number of poles, overload trip setting, and short circuit interrupting rating as indicated. Enclosure type as indicated.

GROUNDING AND BONDING EQUIPMENT

UL 467. Ground rods shall be copper-clad steel, with minimum diameter of 20mm and minimum length of 3 meters.

EXECUTION

INSTALLATION

Electrical installation shall conform to requirements of PEC, NFPA 70 and to requirements specified herein.

1. Underground Service:

Underground service conductors and associated conduit shall be continuous from service entrance equipment to outdoor power system connection.

2. Wiring Methods

Provide insulated conductors installed in conduits, except where specifically indicated or specified otherwise or required by PEC and NFPA 70 to be installed otherwise. Provide insulated, green equipment grounding conductor in feeder and branch circuits, including lighting circuits. Provide insulated, grounding conductors installed in conduits or raceways.

a. Service Entrance Conduit: Rigid Steel Conduit (RSC), conduit underground: PVC schedule 40. The underground portion shall be encased as indicated.

b. Underground Conduit (other than service entrance) PVC where nwi-metallic conduit Is used, shall be converted to plastic - coated rigid steel conduit before rising through floor slab; plastic coating shall extended at least 152mm above floor.

3. Conduit Installation:

Unless indicated otherwise, conceal conduit within finished walls, ceilings, and floors. Keep conduit a minimum of 150mm away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, wails, and structural members where located above accessible ceilings and where conduit will be visible after completion of project. Run conduits in crawl space under slab as if exposed.

a. Where conduits rise through floor slabs, curved portion of bends shall not be visible above finish slab.
b. Conduit Support:

Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded studs, or spring tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceilings shall be vibration resistant and shock resistant. Holes cut to depth of more than 40mm in reinforced concrete beams or to depth of more than 20mm in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations.

c. Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of all obstructions.
d. Install pull wires in empty conduits in which wire is to be installed by others. Pull wire shall be plastic having minimum 91 kgs. tensile strength. Leave minimum 300mm of slack at each end of pull wire.
e. Conduit Installed in Concrete Floor Slabs:

Locate so as not to adversely affect structural strength of slab except at cabinet locations. Curved portions of bends shall not be visible above the finish slab. Increase slab thickness as necessary to provide minimum 25mm cover over conduits. Where embedded conduits cross expansion joints, provide suitable watertight expansion fittings and bonding jumpers. Conduit larger than 25mm trade size shall be parallel with or at right angles to main reinforcement; when at right angles to the reinforcements, the conduit shall be closed to one of the supports of the slab.

f. Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by PEC and NFPA 70, where Insulated bushings are used, and where bushing cannot be brought into firm contact with the box; otherwise, use minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by PEC and NFPA 70.

g. Flexible Connection
Provide flexible connection of short length, 1.8 meters maximum for recessed and semi- recessed lighting fixtures.

4. Boxes, Outlets, and Supports:

Provide boxes in wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when installed exposed up to 2.1 meters above interior floors and walkways, or when installed in hazardous areas. Boxes in other locations shall be sheet steel, except that aluminium boxes may be used with aluminum conduit. Each box shall have the volume required by PEC and NFPA 70 for the number of conductors enclosed in the box. Boxes for mounting lighting fixtures shall not be less than 100 mm2 or octagonal, except that smaller boxes may be installed as required for fixture configurations as approved. Boxes for use in masonry-block or tile walls shall be square- cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature. Fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports, or make adequate provisions for distributing load over ceiling support members. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel.

In open overhead spaces, cast boxes threaded to raceways need not separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved type fastener maximum 600mm from the box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

a. Boxes for use with raceway systems shall be minimum 40mm deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 100mm2, except that 100 by 50mm boxes may be used where only one raceway enters outlet.

b. Pull Boxes:

Construct of at least minimum size required by PEC and NFPA 70 of code-gauge aluminum sheet steel except where cast-metal boxes are required in locations specified herein. Furnish boxes with screw-fastened covers. Where several feeders pass through common pull box, tag the feeders to indicate clearly the electrical characteristics, circuit number, and panel designation.

5. Conductor Identification

Provide conductor identification within each enclosure where a tap, splice, or termination is made.

6. Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Plates shall be installed with an alignment tolerance of 3mm. Use of sectional-type device plates are not permitted. Plates installed in wet locations shall be gasketed.

7. Electrical Penetrations

Openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings shall be sealed to maintain fire resistive integrity as tested per ASTM E 814.

FIELD QUALITY CONTROL:

Furnish test equipment and personnel and submit written copies of test results. Give the Engineer five (5) working days notice prior to each test.

1. Devices Subject to Manual Operation:

The work includes providing lighting fixtures for interior use, including accessories mounted on the exterior surfaces of buildings. Materials not normally furnished by manufacturers of these devices are specified in "Interior Wiring Systems."

SUBMITTALS

Data, shop drawings showing mounting heights, and reports shall employ the terminology, classifications, and methods prescribed by the IES Lighting Handbook, as applicable, for the lighting system specified.

1. Manufacturer's Data:

    a) 2-36wT-8 LED Tubular w/ aluminum reflector (recessed type)
    b) 2-18wT-8 LED Tubular w/ aluminum reflector (recessed type)
    c) Downlight with 11-watt LED light (recessed mounted)
    d) Downlight with 11-watt LED light (surface mounted)
    e) Emergency light

MATERIAL REQUIREMENTS

LED Tubular with aluminum reflector

An LED tubular with aluminum reflector (recessed type) is a ceiling-mounted lighting fixture that utilizes one or more LED tubular lamps (typically T5 or T8 form factor) combined with a high-efficiency aluminum reflector, designed to be recessed into a ceiling cavity. This type of fixture provides uniform, energy-efficient lighting and is widely used in commercial, institutional, and office environments.

LAMP TYPE

- **Type**: LED tubular lamp
- **Shape**: T5 or T8 (commonly used)
- **Base**: G5 (T5) or G13 (T8), or integrated module (if non-replaceable)
- **Wattage**: as indicated

HOUSING / FIXTURE BODY

- **Material**: Powder-coated **steel** or **aluminum** for durability and heat dissipation
- **Finish**: White or anodized aluminum
- **Mounting Type**: Recessed (suitable for T-bar or gypsum ceiling installation)
- **Ingress Protection**: Minimum **IP20** (indoor use)
- **Dimensions**: Match standard modular ceiling grids (e.g., 600x600 mm)

REFLECTOR

- **Material**: High-purity **aluminum**
- **Finish**: Specular (mirror-like) or semi-specular (matte anodized)
- **Function**: Enhance light distribution and reduce glare

- **Reflectivity**: ≥ 85%

LED RECESSED DOWN LIGHT

A recessed downlight, also known as a recessed light, is a type of lighting fixture that is installed into hollow openings in a ceiling or wall, with the housing and electrical components hidden, leaving only the trim and bulb visible. It provides a focused, directional light, typically aimed downwards, and is popular for its sleek, space-saving design and ability to create a clean, modern aesthetic.

- **Type**: Integrated **LED module**
- **Power Rating**: 11 Watt
- **Luminous Efficacy**: ≥ 90–120 lm/W
- **Color Temperature**: 2700K (warm), 4000K (neutral), 6500K (daylight)

INSTALLATION & MOUNTING

- **Recessed**:
  - Ceiling cut-out size must match fixture diameter
  - Installed with spring clips
- **Surface-Mounted**:
  - Installed using a mounting plate and screws
  - Suitable for concrete or slab ceilings

EMERGENCY EXIT LIGHT

An emergency light is a self-contained lighting fixture that automatically provides illumination during a power failure. It is commonly installed in corridors, stairwells, exits, and escape routes to ensure occupant safety and facilitate evacuation during emergencies. Emergency lights are typically powered by a rechargeable battery and include automatic charging and switching circuitry.

They can be either maintained (always on, even during normal power) or non-maintained (only turns on during a power outage), depending on the application and code requirements.

Lamp and Light Source

- **Type**: Integrated LED module
- **LED Power Consumption**: 1W to 5W (in emergency mode)
- **Luminous Flux (Emergency Mode)**: ≥ 100–200 lumens (depending on size)
- **Color Temperature**: 5000K – 6500K (cool daylight for visibility)
- **Lifespan**: ≥ 30,000 hours
- **Viewing Distance** (for exit signs): Typically 24–30 meters, per ISO or local code

RECESS AND FLUSH-MOUNTED FIXTURES

Provide types that can be relamped from the bottom. Trim for the exposed surface of flush- mounted fixtures shall be as indicated.

EXECUTION

INSTALLATION

Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturer's directions and approved shop drawings. The installation shall meet with the requirements of PEC and NFPA 70. Mounting heights specified or indicated shall be to bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before installation commence and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed.

Recessed and semi-recessed fixtures may be supported from suspended ceiling support system ceiling tees if the ceiling system support rods or wires are provided at a minimum of four rods or wires per fixture and located not more than 150mm from each corner of each fixture. Do not support fixtures by ceiling acoustical panels. Where fixtures of size less than the ceiling grid are indicated to be centered in the acoustical panel, support such fixtures independently or with at least two 20mm metal channels spanning, and secured to, the ceiling tees. Provide rods or wires for lighting fixture supports under this section of the specifications. Additionally, for recessed fixtures, provide support clips securely fastened to ceiling grid members, a minimum of one at or near each comer of each fixture.

GROUNDING

Ground non-current-carrying parts of equipment as specified in "Interior Wiring Systems." Where the copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

FIELD TESTS

The Contractor will provide electric power required for field tests.

1. Operating Test:

Upon completion of the installation, conduct an operating test to show that the equipment operate in accordance with the requirements of this section.

2. Insulation Resistance Test:

Perform as specified in "Interior Wiring Systems", both before and after connection of fixtures and equipment.

3. Ground Resistance Tests:

Perform as specified in "Interior Wiring System."

ITEM 15 : AUXILLIARY SYSTEM

BACKGROUND MUSIC / PAGING ALARM (BGM/PA)

GENERAL

Electrical General Requirements applies to this section, with the additions and modifications specified herein.

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. The edition or the revised version of such codes and standards current at the date twenty eight (28) days prior to date of bid submission shall apply. During Contract execution, any changes in such codes and standards shall be applied after approval by the Owner. 1. Electronic Industries Alliance (EIA) EIA ANSI/EIA-310-D (1992) Racks, Panels, and Associated Equipment

1. Institute of Electrical and Electronics Engineers (IEEE)

IEEE C62.41 (1991; R 1995) Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

2. National Fire Protection Association (NFPA)

NFPA 70 (2007) National Electrical Code

NFPA 72 (2002) National Fire Alarm Code

3. Underwriters Laboratories (UL)

UL 1449 (2006) Transient Voltage Surge Suppressors

SUBMITTALS

The following shall be submitted.

1. Shop Drawings

    a. Detail Drawings

Detail drawings as specified.

2. Product Data

    a. Spare Parts

Spare parts data for each different item of material and equipment specified.

3. Test Reports

a. Approved Test Procedures

Test plan and test procedures for the acceptance tests. The test plan and test procedures shall explain in detail, step by step actions and expected results to demonstrate compliance with the requirements specified. The procedure shall also explain methods for simulating the necessary conditions of operation to demonstrate system performance.

b. Acceptance Tests

Test reports in booklet form showing all field tests performed to adjust each component and to prove compliance with the specified performance criteria, upon completion and testing of the installed system. The reports shall include the manufacturer, model number, and serial number of test equipment used in each test. Each report shall indicate the final position of controls and operating mode of the system.

4. Certificates

a. Components

Copies of current approvals or listings issued by UL, or other nationally recognized testing laboratory for all components.

5. Operation and Maintenance Data

a. Public Address System

SYSTEM DESCRIPTION

The public address system shall consist of an audio distribution network to include amplifiers, mixers, microphones, speakers, cabling, and ancillary components required to meet the required system configuration and operation.

1. Multi-Channel System with Paging

The system shall include microphones, microphone outlet receptacles, microphone inputs with preamplifiers, inputs for film sound, compact disc, magnetic tape, telephone, and program sources, single all channel paging, control for each input, power amplifying equipment, and accessories required to output the public address and paging audio signals through selected portions of the audio distribution network as indicated. The paging signal shall replace by zones channel all channels of the radio system output, when the paging function is activated.

2. Single-Channel System

The system shall control and amplify an audio program for distribution within the areas indicated. Components of the system shall include a mixer-amplifier, mixer-amplifier; mike input expander, power amplifier, microphone, speaker system, compact disc, cassette/DVD player, AM-FM tuner, cabling and other associated hardware.

3. System Performance

The system shall provide even sound distribution throughout the designated area, plus or minus 3 dB for the 1/1 octave band centered at 4000 Hz. The system shall provide uniform frequency response throughout the designated area, plus or minus 3 dB as measured with 1/3-octave bands of pink noise at locations across the designated area selected by the Engineer. The system shall be capable of delivering 75 dB average program level with additional 10 dB peaking margin sound pressure level (SPL) in the area at an acoustic distortion level below 5 percent total harmonic distortion (THD). Unless otherwise specified the sound pressure reference level is 20 micro Pascal (0.00002 Newton per square meter).

4. Detail Drawings

The Contractor shall submit detail drawings consisting of a complete list of equipment and material,including manufacturer's descriptive and technical literature, performance charts and curves, catalogue cuts, and installation instructions. Note that the contract drawings show layouts based on typical speakers. The Contractor shall check the layout based on the actual speakers to be installed and make 'necessary revisions in the detail drawings. Detail drawings shall also contain complete point to point wiring, schematic diagrams and other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

5. Spare Parts

The Contractor shall submit spare parts data for each different item of material and equipment specified, after approval of the detail drawings and not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

DELIVERY AND STORAGE

Equipment placed in storage until installation shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

VERIFICATION OF DIMENSIONS

The Contractor shall become familiar with the details of the work and working conditions, shall verify dimensions in the field, and shall advise the Engineers of any discrepancies before performing the work.

MATERIAL REQUIREMENTS

STANDARD PRODUCTS

Material and equipment to be provided shall be the standard products of a manufacturer regularly engaged in the manufacture of such products, and shall essentially duplicate material and equipment that have been in satisfactory use at least 2 years. All components used in the system shall be commercial designs that comply with the requirements specified. Equipment shall be supported by a service organization that is within miles of the site.

SWITCHES AND CONTROLS

1. Radio System Control Switch

The loudspeaker in each room, or group of speakers in a room, shall be provided with a flush program channel selector rotating-switch knob. The switch shall be mounted at location and height above the floor and in accordance with Section 7.5 INTERIOR WIRING SYSTEM. A volume control shall be installed with a switch at each station and shall be of the auto transformer type and set so that the maximum volume is sufficient for the area while not disturbing adjacent areas. If music is turned down or off, the paging signal shall override controls except speakers designated for music only. Each device plate shall be satin finished, corrosion-resisting steel permanently marked to indicate the channel selected.

2. Remote Loudspeaker ON/OFF Switches

Remote switches shall be key-operated, toggle switch 2-pole, wall mounted, single gang type with engraved switch plates finished to match the approved finish of electrical wall switches. Low- voltage priority override relays shall be provided as part of the switches with all wiring to the racks to allow override of the ON/OFF switches for priority announcements.

3. Remote Loudspeaker Volume Controls

Remote volume controls shall be an auto transformer type with detected 3 dB steps and an OFF position. The controls shall be wall mounted in single gang outlet boxes and furnished with engraved switching plates finished to match approved finish of electrical wall switches. Insertion loss of the controls shall not exceed 0.6 dB and the power-handling capacities of the control shall be 10, 35, 75 watts. Low voltage priority override relays shall be furnished as part of these controls with all

wiring to the racks to allow override of the volume controls for priority announcements.

EQUIPMENT RACKS

Equipment shall be mounted on 482.6 mm racks in accordance with EIA ANSI/EIA-310-D and located as shown on drawings. Ventilated rear panels, solid side panels, and solid top panels shall be provided. Equipment racks shall be provided with lockable front panels that limit access to equipment. The lockable front shall not cover items that require operator access such as AM/FM tuner, CD/DVD player, or tape player. Rack cooling shall be through [perforations or louvers in front panels to ensure adequate ventilation of equipment] [top rack mounted fan. The racks and panels shall be factory finished with uniform baked enamel over rust inhibiting primer.

CABLES

1. Speaker Cable

Cables shall be of the gauge required depending upon the cable run length. In no case shall cable be used which is smaller than 18 AWG. Insulation on the conductors shall be polyvinyl chloride (PVC) or an equivalent synthetic thermoplastic not less than 0.2 mm. Cables shall bebjacketed with PVC, Fluor polymer compound. The jacket thickness shall be 0.5 mm minimum.

2. Microphone Cable

Cable conductor shall be stranded copper 20 AWG. Insulation on the conductors shall be polyvinyl chloride (PVC) or an equivalent synthetic thermoplastic not less than 0.2 mm. Cable shall be shielded 100% of aluminum polyester foil with a bare 22 gauge stranded soft copper drain conductor. Cables shall be jacketed with PVC, Fluor polymer compound. The jacket thickness shall be 0.5 mm minimum.

3. Antenna Cable

Antenna coaxial cable shall have 75 ohm plus or minus 2 ohm. Attenuation of the coaxial cable span between the antenna and amplifier shall not exceed 2.5 dB at 108 MHz

TERMINALS

Terminals shall be solder-less, tool-crimped pressure or type.

SURGE PROTECTION

1. Power Line Surge Protection

Major components of the system such as power amplifiers, mixer preamplifiers, and tuners, shall have a device, whether internal or external, which

provides protection against voltage spikes and current surges originating from commercial power sources per IEEE C62.41 B3 combination waveform and NFPA 70. Fuses shall not be used for surge protection. The surge protector shall be rated for a maximum let thru voltage of 350 Volts ac (line to neutral) and 350 Volt ac (neutral to ground). Surge protection device shall be UL listed and labeled as having been tested in accordance with UL 1449.

2. Signal Surge Protection

Major components of the system shall have internal protection circuits which protect the component from mismatched loads, direct current, and shorted output lines. Communication cables/conductors shall have surge protection installed at each point where it exits or enters a building.

EXECUTION

INSTALLATION

Equipment shall be installed as indicated and specified, and in accordance with the manufacturer's recommendations except where otherwise indicated. Equipment mounted out of doors or subject to inclement conditions shall be weatherproofed. The antenna shall be supported at least 1.5 m clear above the roof by means of self supported or guyed mast.

1. Equipment Racks

Racks shall be mounted side by side and bolted together. Items of the same function shall be grouped together, either vertically or side by side. Controls shall be symmetrically arranged at a height as shown. CD/DVD, Cassette & Tuner shall be at a height above the floor as shown.

Audio input and interconnections shall be made with approved shielded cable and plug connectors; output connections may be screw terminal type. All connections to power supplies shall utilize standard male plug and female receptacle connectors with the female receptacle being the source side of the connection. Inputs, outputs, interconnections, test points, and relays shall be accessible at the rear of the equipment rack for maintenance and testing. Each item shall be removable from the rack without disturbing other items or connections. Empty space in equipment racks shall be covered by blank panels so that the entire front of the rack is occupied by panels.

2. Wiring

Wiring shall be installed in rigid steel conduit, intermediate metal conduit, cable trays, or electric metallic tubing as specified in Section 7.5 INTERIOR WIRING SYSTEM. Wiring for microphone, grounding, line level, speaker and power cables

shall be isolated from each other by physical isolation and metallic shielding. Shielding shall be terminated at only one end.

GROUNDING

All grounding practices shall comply with NFPA 70. The antenna mast shall be separately grounded. Equipment shall be grounded to the serving panel board ground bus through a green grounding conductor. Metallic conduits serving the equipment shall be isolated on the equipment end with an insulating bushing to prevent noise from being transferred to the circuit. Equipment racks shall be grounded to the panel board ground bus utilizing a #8 conductor. Grounding conductor shall be terminated to the rack using connector suitable for that purpose.

ACCEPTANCE TESTS

After installation has been completed, the Contractor shall conduct acceptance tests, utilizing the approved test procedures, to demonstrate that equipment operates in accordance with specification requirements. The Contractor shall notify the Engineer 14 days prior to the performance of tests. In no case shall notice be given until after the Contractor has received written Engineer approval of the test plans as specified. The acceptance tests shall include originating and receiving messages at specified stations, at proper volume levels, without cross talk or noise from other links or non- designated units.

TRAINING

The Contractor shall conduct a training course for members of the operating and maintenance staff as designated by the Engineer. The training course will be given at the installation during normal working hours for a total of hours and shall start after the system is functionally complete but prior to final acceptance tests. The field instructions shall cover all of the items contained in the approved operating and maintenance manuals, as well as demonstrations of routine maintenance operations. The Engineer shall be notified at least 14 days prior to the start of the training course.

FIRE DETECTION AND ALARM SYSTEM

GENERAL

"Electrical General Requirements" applies to this section with additions and modifications specified herein.

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition or the revised version of such codes and standards current at the date twenty eight (28) days prior to date of bid submission shall apply. During Contract

execution, any changes in such codes and standards shall be applied after approval by the Owner.

1. Factory Mutual Engineering and Research Corporation (FM)

   FM P7825 (2005) Approval Guide Fire Protection

2. National Fire Protection Association (NFPA)

   NFPA 70 (2005) National Electrical Code

   NFPA 72 (2002) National Fire Alarm Code

   NFPA 90A (2002) Installation of Air Conditioning and Ventilating Systems

   NFPA 101 (2002) Life Safety Code

3. Institute of Integrated Electrical Engineers (IIEE) PEC (2000) Philippine Electrical Code

4. Underwriters Laboratories Inc. (UL)

   UL 268 (1996; Rev thru Oct 2003) Smoke Detectors for

   UL 514A (2004) Metallic Outlet Boxes

   UL 514B (2004) Fittings for Conduit and Outlet Boxes

   UL 864 (2003; Rev Thru Oct 2003) Control Units and Accessories for Fire Alarm Systems

   UL 464 (2003; Rev Thru Oct 2003) Audible Signal Appliances

   UL 1242 (2000; Rev thru May 2003) Intermediate Metal Conduit

   UL 1971 (2000; Rev thru May 2004) Safety Signaling Devices for the Hearing Impaired

   UL 521 (1999; Rev thru Oct 2002) Heat Detectors for Fire Protective Signaling Systems

DESCRIPTION OF WORK

The work includes providing new interior fire alarm system including material, tools, equipment, installation, and testing necessary for and incidental to the provision of a complete and usable standard system conforming to the applicable requirements of PEC, NFPA 70, NFPA 72, NFPA 90A, and NFPA 101, and this specification. Materials and equipment to be furnished under this contract shall be essentially the current design products of manufacturers regularly engaged in production of such equipment and shall be listed by the Underwriters' Laboratories, Inc. in the UL FPED, or approved by Factory Mutual System and listed in FM P7825.

SUBMITTALS

Submit the following.

1. Shop Drawings
    a) System layout
    b) System wiring diagrams
    c) Conductor wire marker schedule
2. Product Data
    a) Control panel and modules
    b) Batteries
    c) Battery charger
    d) Manual pull stations
    e) Smoke detectors
    f) Duct smoke detectors (Optional)
    g) Audio/Visual/Alarm horns
    h) Graphic annunciator panel
    i) Wiring
    j) Conduit
    k) Outlet boxes
    l) Fittings for conduit and outlet boxes

Data which describe more than one type of item shall be clearly marked to indicate which type the Contractor intends to provide.

Submit one original for each item and clear, legible, first generation photocopies for the remainder of the specified copies. Incomplete or illegible photocopies will not be accepted. Partial submittals will not be accepted.

3. Test Reports
4. Preliminary testing
5. Final acceptance testing

Submit for all inspections and tests specified under paragraph entitled "Field Quality Control."

6. Certificates

    a) Qualifications of installer

    b) Qualifications of system technician

7. Operation and Maintenance Data

    a) Fire alarm system

8. Closeout Submittals

    a) System as-built drawings

QUALITY ASSURANCE

1. Qualifications of Installer

The Contractor or installer shall have satisfactorily installed fire alarm systems of the same type and design as specified herein. Prior to commencing fire alarm system work, submit data showing that the Contractor or installer has satisfactorily installed three fire alarm systems of the same type and design as specified herein within the past three years. For each system installed, submit the following:

a) A detailed summary of the type and design of the system;

b) The contract name or number, completion date of the project and total cost of the system;

c) The name and telephone number of the facility or installation for which the work was performed;

2. Manufacturer's Representative

Provide the services of a representative or technician from the manufacturer of the system, experienced in the installation and operation of the type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of the system and to provide instruction to Owner representative.

3. Qualifications of System Technician

Installation drawings, shop drawings and as-built drawings shall be prepared by, or under the supervision of, a qualified technician. Qualified technician shall be an individual who is experienced with the types of work specified herein. Contractor shall submit data showing the name and certification of the technician at or prior to submittal of drawings.

4. Drawing Requirements

a) System Layout

Submit shop drawings of the system layout showing locations of initiating devices and alarm horns. Show wire color coding, wire counts, and device wiring order.

b) System Wiring Diagrams

Submit complete wiring diagrams of the system showing points of connection and terminals used for all electrical connections in the system. Show all modules and lamps in the control panel.

c) System As-Built Drawings

Upon completion, and before final acceptance of the work, furnish to the Engineer 4 complete sets of as-built drawings, including complete as-built circuit diagrams, of each the system. The as built drawings shall be as the contract drawings and with title block similar to contract drawings.

MAINTENANCE

1. Spare Parts

Furnish the following spare parts:

a) Five (5) complete sets of system keys

b) One (1) of each type of audible and visual alarm device installed

c) Two (2) of each type of fuse required by the system

d) One (1) spare zone modules for modular type control panels in addition to those installed in the panel

e) Two (2) of each type of heat detector installed

f) Tow (2) of each type of smoke detector base and head installed

2. Manuals

Submit operation and maintenance data manuals. The manual shall include: circuit drawings; wiring and control diagrams; installation instructions; maintenance instructions; safety precautions, diagrams, and illustrations; test procedures; performance data; and parts list.

MATERIAL REQUIREMENTS

SYSTEM DESIGN

1. Operation

Provide a complete, electrically supervised, zoned, annunciated, fire alarm system as described herein, and as shown on the drawings. Provide separate circuits from the control panel to each zone of initiating devices as specified herein.

a) Fire Alarm Signal Initiation

Operation shall be such that actuation of any:

1. Manual station
2. Smoke detector

Shall cause all of the following actions:

i. All building evacuation alarm devices Audio/visual alarm horns to operate continuously;

ii. The annunciators to properly register.

All operations shall remain in the alarm mode until the system is manually restored to normal.

b) Monitoring Integrity of Installation Conductors

All system circuits shall be electrically monitored for integrity including the following:

a) Initiating circuits.

b) Evacuation alarm circuits

c) Battery power supply low and no voltage across the standby battery terminals and open battery circuit. Provide Class A initiating device circuits, and Class A notification device circuits as defined by NFPA 72. For Class A circuits, provide separate conduits for outgoing and return (redundant) conductors as required by NFPA 72. A ground fault condition or single break in any other circuit shall cause operation of the system trouble signals. Loss of AC power, abnormal AC voltage, a break in the standby battery power circuit, or low battery voltage shall also cause operation of system trouble signals. The abnormal position of any switch in the control panel shall also cause operation of the system trouble signals. Audible and visual equipment for supervision of the AC power supply shall be energized from the auxiliary DC power supply and vice versa. Trouble signals shall sound continuously until manually silenced or the system has been restored to normal.

c) Walk-Test Mode

Provide system with walk-test mode to allow one person to test alarm and supervisory features of initiating devices. Walk-test mode shall be enabled from the control panel by authorized service personnel. Control panel shall display a unique visual indication when system is in walk-test mode. If testing ceases while in walk-test mode, after a preset delay system shall automatically return to normal standby mode.

d) Alarm Verification Feature

System shall have a smoke detector alarm verification feature. Upon activation of any area smoke detector, system shall institute an alarm verification process prior to enabling of the alarm functions as specified herein. Activation of any initiating device other than an area smoke detector shall cause immediate enabling of system into alarm mode. If an alarm input from a smoke detector on the initial zone in alarm is present at the end of an initial delay period not exceeding 20 seconds, all alarm functions as specified herein shall be immediately enabled. If a smoke detector alarm input is not present at the end of the initial delay period, a second-stage confirmation period of one minute shall be initiated. If a smoke detector alarm input is received during the second-stage confirmation period, all alarm functions shall be immediately enabled. During the verification process, activation of any area smoke detector on any zone other than the initial zone in alarm shall also cause system to go into alarm mode immediately. If no smoke detector alarm input occurs within the second-stage confirmation period, system shall reset to normal. Any alarm input received from an area smoke detector after the second-stage confirmation period has elapsed shall cause system to institute a new verification process.

2. Primary Power

Primary power source shall be 240 volts AC service, transformed through a two winding isolation type transformer and rectified to 24 volts DC for operation of all initiating device, notification device signaling line and trouble signal. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the rated output of the system power supply modules. Obtain AC operating power as shown on contract drawings. Provide an independent enclosed circuit breaker with provisions for locking the cover and operating handle in the "POWER ON" position. Paint the enclosure red and identify it by the lettered designation "FIRE ALARM SYSTEM POWER".

3. Auxiliary Power

Provide secondary DC power supply for operation of system in the event of failure of the AC source. Transfer from normal to emergency power or restoration

from emergency to normal power shall be fully automatic and shall not cause transmission of a false alarm.

a) Storage Batteries

Provide sealed lead calcium or sealed lead acid or batteries and charger. Dry cell batteries are not acceptable. House batteries in the control panel. Provide batteries of adequate ampere-hour rating to operate the system, including audible trouble signal devices, and under supervisory conditions for 60 hours, at the end of which time batteries shall be capable of operating the entire system in a full alarm condition for not less than 15 minutes. Provide calculations substantiating the battery capacity. Provide reliable separation between cells to prevent contact between terminals of adjacent cells and between battery terminals and other metal parts.

b) Battery Charger

Provide completely automatic high/low charging rate type capable of recovery of the batteries from full discharge to full charge in 24 hours or less. Provide a trouble light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high rate switch is provided. House charger in the control panel.

COMPONENT DESIGN

1. Control Panel

Control Panel shall comply with the applicable requirements of UL 864. Provide modular type panel installed in a surface mounted steel cabinet with hinged door and cylinder lock. Mount with panel center-line 1.5 m above finished floor elevation. Switches and other controls shall not be accessible without the use of a key. The control panel shall be a neat, compact assembly containing all parts and equipment required to provide specified operating and supervisory functions of the system. Each control panel component shall be UL listed or FM approved and approved by the control panel manufacturer for use in the control panel. Panel cabinet shall be finished on the inside and outside with factory-applied enamel finish. Provide main annunciator located on the exterior of the cabinet door or visible through the cabinet door. Provide audible trouble signal. Provide permanent engraved rigid plastic or metal identification plates, or silk screened labels attached to the rear face of the panel viewing window, for all lamps and switches. Provide panel with the following switches:

a) Trouble silencing switch which silences audible trouble signals without extinguishing trouble indicating lamps. For non-self resetting type switch, upon correction of the trouble condition, audible signals will again sound until the switch is returned to its normal position. For silencing switch of the momentary action, self resetting type, the trouble signal circuit shall

be automatically restored to normal upon correction of the trouble condition.

b) Evacuation alarm silencing switch which when activated will silence all alarm notification devices without resetting the panel, and cause operation of system trouble signals. Subsequent alarms from additional zones not originally in alarm shall cause activation of the notification devices even with the alarm silencing switch in the "silenced" position.

c) Individual zone disconnect switches which when operated will disable only their respective initiating circuit and cause operation of the system and zone trouble signals.

d) Reset switch which when activated will restore the system to normal standby status after the cause of the alarm has been corrected, and all activated initiating devices reset. Operation of reset switch shall restore activated smoke detectors to normal standby status.

e) Lamp test switch.

f) Drill switch which will enable test of notification devices and restoration to normal.

2. Manual Pull Stations

Provide non-coded single action type with mechanical reset features. Stations shall be surface semi-flush mounted and interior type as indicated. For surface mounting provide station manufacturer's approved back box. Back box finish shall match station finish. Equip each station with a terminal strip with contacts of proper number and type to perform functions required. Stations shall be a type not subject to operation by jarring or vibration. Break-glass-front stations are not permitted; however, a pull-lever break-rod type is acceptable provided presence of rod is not required to reset station. Station color shall be red. Station shall provide visible indication of operation. Restoration shall require use of a key. Keys shall be identical throughout the system for all stations and control panel. Mount stations with operating lever not more than 1.2 m above finished floor.

3. Smoke Detectors

Provide smoke detector in accordance with NFPA 101, Life Safety Code. Provide detectors designed for detection of abnormal smoke densities by the photoelectric principle. Detectors shall be 4-wire type. Provide necessary control and power modules required for operation integral with the control panel. Detectors and associated modules shall be compatible with the control panel and shall be suitable for use in a supervised circuit. Malfunction of the electrical circuits to the detector or its control or power units shall result in the operation of the system trouble signals. Each detector shall contain a visible indicator lamp that shall flash when the detector

is in the normal standby mode and shall glow continuously when the detector is activated. Each detector shall be the plug-in type with tab-lock or twist-lock, quick disconnect head and separate base in which the detector base contains screw terminals for making all wiring connections. Detector head shall be removable from its base without disconnecting any wires. Removal of detector head from its base shall cause activation of system trouble signals. Each detector shall be screened to prevent the entrance of insects into the detection chambers.

4. Notification Devices

Provide in accordance with NFPA 72 and as indicated. Do not exceed 80 percent of the listed rating in amperes of any notification device circuit. Additional circuits above those shown shall be provided if required to meet this requirement. Effective sound levels shall comply with NFPA 72. Provide devices in addition to those shown if required in order to meet NFPA 72 sound level requirements.

a) Alarm Horns

Surface-mounted vibrating type suitable for use in an electrically supervised circuit and shall have a sound output rating of at least 90 decibels at 3 m, when tested in accordance with UL 464 while emitting a slow whoop tone.

b) Visible Devices

Surface-mounted assembly of the stroboscopic type suitable for use in an electrically supervised circuit and powered from the notification device circuits. Devices shall provide a minimum of 75 candela measured in accordance with UL 1971, but in no case less than the effective intensity required by NFPA 72 for the device spacing and location shown. Lamps shall be protected by a thermoplastic lens and labeled "FIRE" in letters at least 12 mm high. Provide visible devices within 300 mm of each audible appliance and as indicated. Visible devices may be part of an audio-visual assembly. Where more than two devices are located in the same room or corridor, provide synchronized operation.

5. Conduit

a) Intermediate Metal Conduit (IMC) UL 1242, zinc-coated steel only.

6. Outlet Boxes UL 514A, zinc-coated steel.

7. Fittings for Conduit and Outlet Boxes UL 514B, zinc-coated steel.

8. Wiring

NFPA 70, PEC and NFPA 72. Wire for 240V circuits shall be 3.5 mm2 minimum copper conductors. Wire for low voltage DC circuits shall be 2.0 mm2

minimum copper conductors insulation shall be 75 degree C minimum with nylon jacket. Color codes all wiring.

EXECUTION

INSTALLATION

Installation shall be in accordance with the requirements of NFPA 70, PEC NFPA 72 and NFPA 90A. Each conductor used for the same specific function shall be distinctively color coded. Each function color code shall remain consistent throughout the system. Use colors as directed by the Engineer. All wiring shall be in steel conduit. All circuit conductors shall be identified within each enclosure where a tap, splice or termination is made. Conductor identification shall be by plastic coated self sticking printed markers. The markers shall be attached in a manner that will not permit accidental detachment. Control circuit terminations shall be properly identified. Wire devices so that their removal will activate system trouble signals. Pigtail or "T" tap connections are prohibited. Wiring for DC circuits shall not be permitted in the same conduit or tubing as wiring for AC circuits. Paint all junction box covers red or provide them with permanent labels reading "FIRE ALARM CIRCUIT." Provide a written schedule of conductor markings identifying each wire marker, the purpose, the origin, and termination point of each conductor. The conductor wire marker schedule shall be turned over to the Engineer at the time of preliminary testing with as built drawings.

1. Additional Installation Requirements

Pull all conductors splice free. Make all conductor connections under screw terminals. Provide insulated barrier type terminal strips at junction points. Use of wire nuts, crimped connectors, or twisting of conductors is prohibited. All control panels shall be dressed out in a professional manner with all wires running in the vertical or horizontal plane, cut to exact length, making all tums at 90 degree angles, and tightly bundled and wire wrapped. Conduit may not enter the top of control panel cabinet.

FIELD QUALITY CONTROL

1. Preliminary Testing

Notify Engineer prior to performing preliminary testing. Contractor shall conduct the following tests during installation of wiring and system components. Any deficiency pertaining to these requirements shall be corrected by the Contractor prior to final acceptance testing of the system. Record results of testing. Submit all test results to the Engineer.

a) Operation of Entire System. Operate all initiating and indicating devices.

b) Operation of Supervisory Systems: Operate all portions to demonstrate correctness of installation.

c) Smoke Detector Test: Clean the smoke detectors in accordance with the manufacturer's recommended procedures. Test smoke detectors using magnet-activated test switch, manufacturer provided test card, or smoke. Use of aerosol sprays to test smoke detectors is prohibited.

2. Final Acceptance Testing

The Contractor shall notify the Engineer when the system is ready for final acceptance testing. Request scheduling for final acceptance testing only after all necessary preliminary tests have been made and all deficiencies found have been corrected to the satisfaction of the equipment manufacturer's technical representative and the Engineer and written certification to this effect has been received by the Fire Protection Engineer. The system shall be in service at least 15 calendar days prior to final acceptance testing. The Contractor shall allow at least 15 calendar days between the dates final testing is requested and the date the final acceptance testing takes place. The Contractor shall furnish all equipment, instruments, devices and personnel for this test. The system Shall be tested for approval in the presence of representatives of the manufacturer, the Engineer, and the Fire Protection Engineer. All necessary tests shall be made including the following, and any deficiency found shall be corrected and the system retested.

a) Entire System

Test the entire system by operating all fire alarm initiating, notification, and signaling devices. Perform tests with the system operating on primary power and repeat the test with the system operating on battery power only. Provide necessary equipment to test smoke detectors and heat detectors.

b) Supervisory Systems

All aspects of the supervisory functions of the systems shall be operated. Introduce faults in each circuit at random locations as directed by the Fire Protection Engineer. Verify proper trouble annunciation at the control panel.

3. Additional Tests

When deficiencies, defects or malfunctions develop during the tests required, all further testing of the system shall be suspended until proper adjustments, corrections or revisions have been made to assure proper performance of the system. If these revisions require more than a nominal delay, the Engineer shall be notified when the additional work has been completed, to arrange a new inspection

and test of the fire alarm system. All tests required shall be repeated prior to final acceptance, unless directed otherwise.

TELEPHONE SYSTEM

GENERAL

Electrical General Requirements applies to this section with the additions and modifications specified herein.

DESCRIPTION OF WORK

The telephone/data system shall consist of an interior system of conduits, outlet, boxes, junction boxes, main distribution frame (MDF) for interconnection of PABX system, telephone/data terminals, telephone/data distribution cables.

Should there be conflicts between these specifications and the plans, or conflicts within specifications and plans, these shall be brought to the attention of the Engineer for resolution.

PRODUCTS

CONDUIT AND FITTINGS

a) Conduit shall be polyvinyl-chloride conduit (PVC) where specified, shalt be heavy wall, high impact resistant Schedule 40, with factory made bends, couplings and fittings. PVC cement for joints shall be of the same brand as for the PVC pipe.

b) No conduits shall be used in any system smaller than 20mm (1/2") diameter electric trade size, nor shall have more than four (4) 90 degree bends in any one run and where necessary, pull boxes shall be provided as directed.

c) No wire shall be pulled into any conduit until the conduit system is completed in all details, in the case of concealed work until all rough plastering masonry has been completed, and in the case of exposed work until the conduit work has been completed in every detail.

d) The ends of all conduits shall have tightly plugged to exclude plaster, dust and moisture while the construction of the building is in progress. All conduits shall be reamed to remove all burrs.

OUTLETS, BOXES AND FITTINGS

a) At all outlets whatever kind, for all system, there shall be provided a suitable fitting, which shall be either a box or other device especially designed to receive the type of fitting to be mounted thereon.

b) The Contractor shall consult with the Engineer as to the nature of the various fittings to be used before installing his outlet fittings, and shall conform strictly in the use of fittings, to the nature of the appliance to be mounted on them, so that the work, when the completed will be a finished design.

c) All outlets on concealed conduit work, provide galvanized pressed steel outlet boxes on standard make. These boxes shall be in all cases standard and where such boxes are not available on the market, special boxes shall be secured by the Contractor at his own expense. In general outlet boxes shall be at least 100mm diameter, 53mm deep and No. 16 minimum gauge.

JUNCTION AND PULL BOXES

a) Junction and pull boxes, of code gauge steel, galvanized shall be provided as indicated or as required for facilitating the pulling of wires and cables. Pull boxes as finished places shall be located and installed with the permission and to the satisfaction of the Engineer.

b) All junction and pull boxes on exposed conduit work shall be provided with hubs for threaded pipe entry and covers provided with neoprene gaskets.

MAIN TELEPHONE TERMINAL CABINET (MTTC) / INTERCONNECTION OF PABX SYSTEM

a) All components, connections of MTTC shall conform to EIA/TIA standards.

b) Cable terminals shall be the type acceptable to the Telephone Company. Terminals shall be Category 5 as required on the plans.

TELEPHONE TERMINALS

The telephone terminals shall be wall mounted, terminal blocks shall be mounted or 20mm thick treated wood backboard. Terminal blocks shall be based on cross connection system. Terminal blocks shall have similar design with MTTC.

HORIZONTAL CABLE

All horizontal cabling shall be Category 5E (RJ-45) network cables.

TELEPHONE / DATA OUTLETS

All modular jacks shall be data grade Category 5.

SHOP DRAWINGS

Prepare and submit complete shop drawings for the telephone system in accordance with the latest Local Telephone Company.

COMMUNITY ANTENNA TELEVISION SYSTEM (CATV)

GENERAL

Electrical General Requirements applies to this section, with the additions and modifications specified herein.

REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition or the revised version of such codes and standards current at the date twenty eight (28) days prior to date of bid submission shall apply. During Contract execution, any changes in such codes and standards shall be applied after approval by the Owner.

1. American Association of State Highway and Transportation Officials (AASHTO) AASHTO HB14 (1992) Highway Bridges

2. American National Standards Institute (ANSI)

   ANSI C2 (1997) National Electrical Safety Code

3. Code of Federal Regulations (CFR)

   29 CFR 1910.27 Fixed Ladders

   47 CFR 76 Cable Television Service

   47 CFR 76.605 Technical Standards

4. Electronic Industries Association (EIA)

   ANSI/EIA/TIA-222-F (1996) Steel Antenna Towers and Antenna Supporting Structures

   ANSI/EIA-412-A (1974) Direct View High Resolution Monochrome Closed Circuit Television Monitors

5. Federal Aviation Administration (FAA)

   FAA AC-70/7460-1 (Rev. H) Obstruction Marking and Lighting

6. Institute of Electrical And Electronics Engineers, Inc. (IEEE)

   EEE C62.41 (1991) Surge Voltages in Low-Voltage AC Power Circuits

7. National Cable Television Association (NCTA)

   NCTA 02 (1989) Measurements on Cable Television Systems

8. National Electrical Manufacturers Association (NEMA)

   NEMA 250 (1991) Enclosures for Electrical Equipment (1000 Votts Maximum)

9. National Fire Protection Association (NFPA)

   NFPA 70 (2007) National Electrical Code

   NFPA 780 (1995) Lightning Protection Code

10. Institute of Integrated Electrical Engineers of the Philippines (IIEE)

    PEC (2000) Philippine Electrical Code

11. Philippine National Standard (PNS)

    BS (2002) Bureau of Standard

SYSTEM DESCRIPTION

1. CATV

Community Antenna Television (CATV) System is a network of cables, headend, and electronic components that process and amplify television (TV) and frequency-modulated (FM) radio signals for distribution from one central location equipped with a common system of antennas to TV sets housed in numerous buildings situated in a community or campus-like environment.

a) Headend

Headend contains the antennas necessary to receive desired signals and electronic equipment to filter the signals, multiplex them for transmission, and amplify them to adequate level to feed the distribution system.

b) Distribution System

Distribution system transports and delivers adequate signals to each receiver. Provides distortion-free signal to TV sets by isolating each receiver from the system and by providing proper amount of signal to each set.

c) Local Programming

Cameras, video recorders, and switchers to permit the facility to present pre-recorded or live programs.

2. Cable

Trunk cable is a low-loss cable used to transport the desired signal from the head-end equipment into the general area to be served. Feeder cables are connected to the trunk cable through bridging amplifiers and are used to transport signal into close proximity to a number of user locations. Subscriber

service cable is used to transport the signal from the feeder cable to the user's building, as stated in this section, interior cable is used within the building to transport signal to user's wall outlet.

3. System Components

System shall provide high quality TV and FM signals to all outlets. Provide any combination of items specified herein to achieve required performance, subject to approvals, limitations, acceptance test, and other requirements specified herein. System shall include antennas; antenna towers; band-pass filters; mixers; preamplifiers; power supplies; converters; TV monitors; cables; wall taps; and all other parts, components, and equipment necessary to provide a complete and usable system.

SUBPART A Rules.

d) Extension of Existing System

The new distribution system extension shall not degrade the quality of the signals identified in the paragraph entitled "System Input" by more than those indicated in the paragraph entitled "Distribution System." Measurements shall be made at the far end extremities of the new extension.

e) All New System Tolerance

The system shall not show a serious loss of signal to noise when the system levels are lowered 3 dB below normal or a significant distortion when the levels are increased 3 dB above normal, as observed on a TV set located at the far end extremities of the system.

SUBMITTALS

Submit the following:

1. Shop Drawings

a) CATV system wiring diagrams and installation details

b) CATV system components

2. Product Data

a) Antennas

b) Antenna towers

c) Pre-amplifiers

d) Splitters/combiners

e) Multiplexers

f) Amplifiers, including head-end, trunk, bridging, and distribution

g) Power supplies

h) Attenuators

i) Traps

j) Band-pass filters

k) Terminators

l) Line tap-off

m) Matching transformers

n) Wall taps

o) Set top converters

p) TV monitors

q) Cables, including trunk, feeder, subscriber service, and interior

r) CATV housings/pedestals

s) Grounding block

t) Ground rods

u) Drop wire clamps

v) Local programming equipment

Submittals for each manufactured item shall be the current manufacturer's descriptive literature of catalogue products, equipment drawings, diagrams, performance and characteristics curves, and catalogue cuts.

3. Test Reports

   a) Signal survey

   b) Ground rod tests

   c) System pre-test

   d) Acceptance tests

   e) Operational test plan

f) Operational test procedures

g) Ground rod test procedure

4. Operation and Maintenance Data

a) CATV system,

Submit operation and maintenance data. Submit a draft copy with the acceptance test procedure for use during the site test, and update with all changes required prior to final acceptance. Update all operation and maintenance data to include modifications made during installation, checkout, and acceptance.

QUALITY ASSURANCE

1. Wiring Diagrams and Installation Details

Illustrate how each item of equipment functions in the system and include an overall system schematic indicating the relationship of MATV/CATV units on one diagram. Drawings shall include wiring diagrams and installation details of equipment indicating proposed locations, layout and arrangements, and other items that must be shown to ensure coordinated installation.

2. Operational Test Plan

Test plan shall define tests required to ensure that the system meets technical, operational, and performance specifications. Test plan shall be based on NCTA 02.

3. Operational Test Procedures

Use test plan and design documents to develop test procedures. Procedures shall consists of detailed instructions for a test setup, execution, and evaluation of test results.

4. Ground Rod Test Procedure

Submit three copies of manufacturer's procedure for using the ground

MATERIAL REQUIREMENTS

ELECTRONIC EQUIPMENT

Electronic equipment shall be produced and designed by the same manufacturer with major components of the equipment to have the manufacturer's name, model, and serial number permanently attached. Equipment shall function properly as a complete integrated system.

HEADEND EQUIPMENT

1. Antennas

Heavy-duty, professional quality antennas shall be designed to withstand a minimum wind load of [200] km/h. Elements shall have sealed ends [low band element shall be fibre filled. The boom shall not contain open holes. Antennas shall match a 75-ohm transmission line. Front-to-back ratio shall be 15 dB or higher. Matching devices shall be completely encapsulated so as to be weatherproof.

2. Antenna Towers

Towers shall be self-supporting and shall be capable of withstanding a minimum wind load of 200 km/h and shall be designed so that tower members form a natural ladder for climbing the full length of the tower.

3. Preamplifiers

When required, preamplifiers shall be antenna- or mast-mounted with power duplexed on the down lead. Preamplifiers shall be weatherproof and shall be capable of operating in temperatures of minus 30 to plus 60 degrees Celsius (C).

4. Modulators

Provide an audio-video modulator for each channel of locally originated programming.

5. Channel Converters

Use crystal-controlled oscillators. Single-component failure shall not affect more than one channel in the system.

6. Distribution Amplifiers

Provide [broadband] [single-channel] distribution amplifiers.

7. Traps

Traps shall be designed to reject any transmission interfering with desired signal reception.

8. Attenuators

Provide attenuators to equalize signal levels when required. Variable attenuators are not permitted.

9. Multiplexers

Use multiplexers to combine signals from multiple antennas. Use at the local program originating location to prevent overloading the local TV receiver.

10. Splitters/Combiners

Use splitters/combiners with characteristics equal to or exceeding the characteristics listed in this paragraph over the entire operating band.

All unused outlets must be terminated with 75-ohm terminators.

a) Slope: 0.8 dB.

b) Return loss: 15 dB.

11. TV Monitors

Use TV monitors that comply with ANSI/EIA-412-A.

12. TV Mountings

Use TV flush wall mountings and TV shelf wall mountings.

13. Power Supplies

Power supplies shall contain a current limiter circuit to protect against short circuits on the radio frequency (RF) line. Provide over-voltage protection to protect solid state equipment from line surges and induced voltages, IEEE C62.41.

DISTRIBUTION EQUIPMENT

1. Distribution Amplifiers

Distribution amplifiers shall be equipped for 75-ohm input and output impedance. Electronic equipment exposed to weather shall be equipped with weatherproof housings.

a) Trunk Amplifiers

Trunk amplifiers shall have automatic level and slope features.

b) Bridging Amplifiers

Bridging amplifiers shall be used to connect feeder cables to trunk cables.

2. Cables and Associated Hardware

a) Trunk Cable

For aerial cable construction, coaxial cable shall have the following characteristics:

1. Copper-clad aluminum center conductor.

2. 2.28mmØ.

3. Foam polyethylene dielectric.
4. Seamless aluminum tubing shield.
5. 75 ohms impedance.
6. 1.5 dB 30.48 m of loss at 211 MHz

Cable shall be protected by a black polyethylene jacket with a flooding compound between the jacket and the aluminum shield. For direct burial construction or for cable in conduit, the same cable shall be used and protected by a black polyethylene jacket with a flooding compound between the jacket and the aluminum shield.

b) Feeder Cable

c) CATV Housings/Pedestals

CATV housings/pedestals shall be weatherproof, sized as required, and shalt comply with NEMA 250.

d) Subscriber Service Cable

Coaxial cable shall have the following characteristics:

1. Copper-covered steel center conductor.
2. 30 percent conductivity.
3. 0.813mmØ

3. Foam polyethylene dielectric.

Shield shall have an inner surface of overlapped tape consisting of polypropylene encased in aluminum and an outer surface of tape consisting of polypropylene encased in aluminum with an overlap approximately 3.14 rad apart from the overlap point of the inner tape. The assembly shall be protected by a polyethylene jacket with a flooding compound between the jacket and the outer shield. Cable shall exhibit 75-ohm impedance and a maximum loss of 4.2 dB 30.48 m at 211 MHz.

e) Interior Cable

RG-6 / RG-59 type cable having the following characteristics:

1. Copper-covered steel center conductor.
2. 30 percent conductivity.
3. 0.813mmØ

4. Foam polyethylene dielectric.

Shield shall consist of a polypropylene braid encased in aluminum with an effective shielding 81 dB down and protected by a polyvinyl chloride jacket. Cable shall exhibit 75-ohm impedance and a maximum loss of 4.2 dB 30.48 m at 211 MHz.

f) Drop wire Clamps

For terminating aerial subscriber service cable without a strength member, use a non-crushing clamp. For terminating cable with a strength-supporting member, such as a figure-8 cable, terminate the strength member using a wire vise dead end.

g) Grounding Block

Provide a corrosion-resistant grounding block suitable for outdoor installation.

h) Ground Rods

Provide [copper-encased steel] [copper-clad steel], [sectional-type] ground rods at least 19 mm in diameter and at least 3050mm long. Die-stamp each, near the top, with the name or trademark of the manufacturer and the length of the rod in millimeters. Rods shall have a continuous surface that is hard, clean, and smooth throughout the length of the rod.

5. Terminators

Terminators shall be rated for 75 ohms and 1/4 watt and shall be equipped for power blocking.

6. Line Tap-offs

Line tap-offs shall have 18 dB minimum isolation from each tap to the thru-line. Pressure tap-offs are not permitted.

7. Wall taps

Provide flush-mounted, surface-mounted, 75-ohm, F-type connectors, brown off-white, wall taps. Provide flush-mounted wall taps mounted in standard electrical outlet boxes, and surface-mounted wall taps mounted in surface housings.

EXECUTION

INSTALLATION

1. Antenna System

a) Reception

Provide and orient antennas so that they supply the desired channels with maximum spurious-response rejection and minimal ghost imaging. When necessary to achieve the required input signal characteristics, provide and orient separate antennas for the best reception of each channel.

b) Antenna Mounts

Mount antennas on masts attached to a tower or wall or, antennas shall not be secured to a roof unless special authorization is obtained from the Contracting Officer and appropriate protection of the roof integrity is provided. Antennas shall not be attached to chimneys or vent pipes. Mast shall be securely mounted to adjacent structures with a minimum of three mounting brackets spread at 460 mm minimum intervals. Fasten the mounting brackets with lag bolts a minimum of 9.525 mm diameter or expansion anchors sized for bolts a minimum of 9.525 mm diameter. Mast attachments to mortar or grout joints are not permitted. Securely tighten the mounting hardware, antenna hardware, and the terminals.

c) Corrosion Protection and Wind Loading

All mounting and antenna assembly hardware shall be corrosion resistant. Design antennas and mounting devices to withstand a wind load of 200 km/h.

d) Anchoring

Antenna towers shall be either self supporting or free standing. Base of the tower shall be anchored to concrete legs. Foundations shall be designed for a maximum soil-bearing capacity of MPa and proportioned to provide a safety factor of 2.0 against uplift due to overturning, except that he minimum weight of the concrete footing alone, not considering the weight of the earth cover, shall provide a safety factor of 1.0. Towers shall be designed to resist forces generated by winds of km/h. Steel antenna towers and antenna supporting structures shall be designed, fabricated, and provided in accordance with applicable requirements of ANSI/EIA/TIA-222-F; except that for factory finish, the hot-dipped galvanizing process shall provide a zinc coating of 0.001218 g/mm2 of surface.

e) Ladders, Obstruction Lights and Anti climbing

Provide antenna towers with a system of horizontal members to serve as a ladder. Towers exceeding 6 meters in height shall be provided with a safety ladder device designed, fabricated, and provided in accordance with 29 CFR 1910.27.

Provide appropriate anti-climb devices or security fencing around the tower] to prevent unauthorized climbing of the tower. When necessary, towers shall be provided with obstruction lights and markings in accordance with FAA AC-70/7460-1.

f) Lightning Protection and Grounding

Provide antenna system with lightning protection in accordance with NFPA 780. Provide grounding at the base or at the lowest point of the metallic towers. Connect at least two columns by No. 2/0 AWG copper cable to ground in accordance with NFPA 780. Structures adjacent to metallic towers and within their cone of protection do not require primary protection; but all metal frames, ventilators, doors, and window frames shall be bonded together and grounded. Provide antenna lead-ins with spark gap protection connected to ground adjacent to the supporting structure of the antennas.

2. Head-end

Provide head end equipment in the location identified on the drawings; mount the equipment in Contractor-provided racks.

3. Distribution System

Distribution system shall conform to cable routing and equipment locations as shown on the facility layout drawing. Installation shall be in accordance with ANSI C2.

a) Exterior Aerial Cable System

i. Existing pole line plant: Modify and expand the existing pole line, when required, to provide strength and clearance in conformance with ANSI C2. When pole line extension is required, provide in accordance with Section 16301N, "Overhead Transmission and Distribution." Provide all new required materials and hardware.

ii. New pole line plant: Provide in accordance with Section 16301N, "Overhead Transmission and Distribution."

iii. Aerial cable: Do not bend the cable more than the minimum radius recommended by the manufacturer, based on the type of sheath used. Attach equipment housings containing the electronic equipment to the strand, and connect the cable shield to the housings. Ground the assembly in accordance with ANSI C2, when possible or to a driven ground rod assembly with a maximum 25 ohms resistance as measured by a ground resistance meter. This measurement must be satisfied before connecting the ground to the equipment housing. For a cable section exceeding 300 meters between equipment mountings, provide intermediate grounds.

Provide subscriber service cable from the feeder cable to the building. For distances greater than 30 meters, provide cable with a strength member. Terminate the cable in a grounding block. Connect the grounding block to a grounding system having a maximum 25 ohms resistance.

b) Exterior Conduit Systems

Provide the electronic equipment in weatherproof housings.

Attach the housings to manhole, hand-hole walls with corrosion resistant hardware.

i. Existing exterior conduit system: Use only manholes and empty conduits reserved exclusively for telecommunications cables. If it is necessary to provide electronic equipment between existing manholes, Contractor shall provide the necessary conduit and manholes, hand holes in accordance with Section 7.4, "Underground Electrical Works." The word "TELEPHONE" shall be cast in the top face of all new manholes, hand-hole covers. All manholes, hand holes in streets must be rated AASHTO HB14 Class 20 wheel loading. Attach the weatherproof housings containing the electronic equipment to the manhole, hand-hole wall with corrosion-resistant hardware.

c) Direct Buried Cable

Provide buried cable in accordance with Section Section 7.4, "Underground Electrical Works." Provide CATV weatherproof housings/pedestals, hand holes. The new housing/pedestals, hand holes for the electronic equipment are not indicated on the drawings but shall be provided. Attach electronic equipment with corrosion-resistant fasteners in these housings/pedestals, hand holes. Connect cable conductors to the electronic equipment, and connect the shield to the equipment housing. Provide and connect the equipment housing to a grounding system, having a maximum 25-ohm resistance. Provide subscriber service cable to the building, and terminate in a grounding block. Provide and connect the grounding block to a grounding system, having a maximum 25 ohms resistance.

d) Grounding Block

Provide the grounding block [inside] [outside]. Ground this device [according to the requirements of ANSI C2] [to a continuous length of metal cold water pipe without insulating joints and to a ground rod assembly driven a minimum of 150 mm below the surface of the surrounding earth]. Resistance, as measured by a ground resistance meter, shall be a maximum of 25 ohms.

e) Interior Cable

Provide interior cable in conduit in compliance with NFPA 70 and in accordance with Section 7.5, "Interior Wiring System." Provide cable to grounding blocks, to line tap-offs, and to wall taps.

4. TV and FM Receivers

Provide required coaxial connector cable or kits to connect one existing TV receiver located within 1825 mm from the wall tap.

SIGNAL SURVEY

Conduct a signal survey to determine the best antenna location and orientation and the type of antennas required for receiving desired signal levels and rejection of undesired signals.

FIELD TESTING

1. Ground Rod Tests

Test ground rods for ground resistance value before the wire is connected. Use a portable ground testing megohmmeter to test each ground or group of grounds. Instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the value of the ground electrode under test.

2. System Pretest

Upon completing installation of the CATV system, the Contractor shall align and balance the system and shall perform complete pretesting. During the system pre-test, Contractor utilizing the approved spectrum analyzer or signal level meter shall verify that the system is fully operational and meets all the system performance requirements of the specification. Contractor shall measure and record the video and audio carrier levels of each channel at each of the following points in the system:

a) Antenna outputs.

b) Pre-amplifier outputs.

c) Head-end output.

d) Distribution amplifier inputs and outputs.

e) Last outlet of each section of cable.

f) A random sampling of 25 percent of the outlets.

3. Acceptance Tests

Contractor shall notify the Contracting Officer of system readiness 10 days prior to the date of acceptance testing. CATV system shall be tested in accordance with the approved test plan in the presence of the Contracting Officer's representative to certify acceptable performance. System test shall verify that the total system meets all the requirements of the specification and complies with the specified standards. Deficiencies revealed by the testing shall be corrected and revalidated by follow-up testing.

INSTRUCTIONS AND TRAINING

1. Instructions to Government Personnel

Supply the services of competent instructors to give complete instructions to designated personnel in the operation, adjustment, and maintenance of the CATV system and related equipment. Instructions shall include alarm indications, required corrective action, and pertinent safety requirements. Supply operational training for the local programming equipment. Orient the training specifically to the system provided. The number of training days (8-hour days) of instruction shall be for the CATV system and for the local programming equipment.

2. Training Documentation

Supply training manuals for each trainee and one additional copy for the library. Manuals shall describe in detail the information included in each training program. Lesson plans and list of reference material shall also be supplied.

ITEM 16 : AIR CONDITIONING UNIT

GENERAL

"Mechanical General Requirements" applies to this section with additions and modification specified herein.

GENERAL REQUIREMENTS

1. Air-Conditioning System

Air conditioning units in retail stores shall be supplied and installed by the tenant. Capacity of equipment shall not be less than that indicated. In the NFPA standards and SMACNA manuals referred herein, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. Reference to the "authority having jurisdiction" shall be interpreted to mean the Engineer.

2. Refrigerant Piping, Fittings and Accessories

Refrigerant piping assembly as used in this section includes pipes, flanges, bolting, gaskets, valves, relief devices, fittings, and the pressure containing parts of other piping components. It also includes hangers and supports and other equipment items necessary to prevent over stressing the pressure containing parts.

a) Piping

ANSI 15 and ANSI B31.5. Compatible with fluids for which they are being used and capable of withstanding the pressures and temperatures of the service that they are handling.

b) Tubing

Refrigerant piping shall be seamless copper tubing, hard drawn, type K, ASTM B88. Tubing used for refrigerant service shall be cleaned, sealed, capped or plugged prior to being shipped from the manufacturer's plant. Fittings for copper tubing shall be wrought copper or bronze, brazing or solder joint type ANSI B16.18 or ANSI B16.22. Copper flared type tubing may be made only in annealed copper tubing ASTM B280 and in nominal sizes smaller than one- inch only for connection to equipment and no larger than 1-3/8 inches diameter for other connections. Flanges shall be of bronze ANSI B16.24.

3. Corrosion Prevention

Unless specified otherwise, equipment fabricated from ferrous metals that do not have a zinc coating shall be treated for prevention of rust with a factory coating or paint system that will withstand 125 hours in a salts-pray fog test except that equipment located outdoors shall be tested for 500 hours. The salt-spray fog test

shall use a 20 percent sodium chloride solution. Immediately after completion of the test, the coating shall show no signs of blistering, wrinkling or cracking, no loss of adhesion, and the specimen shall show no signs of rust creep age beyond 1/8 inch on either side of the scratch mark. The film thickness of the factory coating or paint system applied on the equipment shall be not less than film thickness used on the test specimen.

4. Safety Standards

a) Design, Manufacture and Installation of Mechanical Refrigeration Equipment: ASHRAE Safety Code for Mechanical Refrigeration.

b) Machinery Guards: Fully guard drive mechanisms, or other moving parts. Provide guards fabricated of steel and expanded metal, rigidly mounted, and readily removed without disassembly.

MATERIAL REQUIREMENTS

AIR-CONDITIONING SYSTEMS - SPLIT TYPES

1. General

The air-conditioning systems shall be designed, constructed, and rating tested in accordance with ARI Standard 210 for unitary air-conditioning equipment of capacities below 135,000 Btu's per hour and ARI Standard 300 for unitary equipment with capacities of 135,000 Btu's per hour and greater. Units shall be ARI certified. Units with capacities below 135,000 Btu's per hour shall be listed in the ARI Directory of Certified Unitary Air-Conditioners.

2. Performance Rating

Cooling capacity of unit shall meet the sensible heat requirements and total requirements indicated. In selecting unit size, make true allowance for "sensible to total heat ratio" to satisfy required sensible cooling capacity. Submittals shall include catalogue selection data which accounts for sensible to total heat ratio, entering air-conditions at evaporator, and condenser air-conditions.

3. Air Conditioners, Ceiling Cassette Type

The air conditioning system has a 4-way air distribution with auto sweep, it can cool an adjacent room using of the 4-way airflow outlets The fresh air intake device and additional outlet grille can condition the air in an adjoining room using one of its 4-way airflow sides.

4. Compressors

Provide hermetic, semi-hermetic rotary, or screw type provided with all the minimum standard equipment and accessories listed therein. Compressor speed for compressors above 20 tons shall not exceed 1750 rpm. Provide compressors with automatic capacity reduction of at least 50 percent for units over 10 tons. Compressors shall start unloaded. Provide each compressor with devices to protect the compressor from short-cycling when shut-down by safety controls. Provide a pump-down cycle of the non-recycling start type for each compressor 20 tons and over. Provide compressors with vibration isolators. Compressor motor shall be suitable for electric power characteristics as indicated. Motor shall conform to NEMA NG-1. Motor starters shall conform to NEMA ICS. Motors shall be constant speed, squirrel-cage induction, open type or hermetically sealed, low starting current, high-torque type, and shall be furnished with reduced voltage or and magnetic across-the-line type motor starter with weather-resistant enclosures

5. Coils

a) Cooling coils shall conform to ARI 410 and to paragraph entitled, Cooling Coils. Coils shall be the type indicated or specified herein.

b) The air-cooled condenser coil shall be extended-surface fin-and-tube type with seamless copper or aluminum construction. Aluminum alloy conforming to ASTM B210, alloy 1100, shall be used for the tubes, and aluminum alloy conforming to chemical requirements of ASTM B209, alloy 7072, shall be used for fins and sheets. Fins shall be soldered or mechanically bonded to tubes and installed in a metal casing. Coils shall be air tested under water for leakage. After testing, dry coils for remote type units to remove free moisture, and cap to prevent entrance of foreign matter. Evacuate and seal coils at the factory.

6. Filter Boxes

Provide filter boxes with either hanged access doors or removable panels. Filter boxes shalt have racks for filters arranged for angle pattern. Filters shall be of type indicated and shall conform to paragraph hereinafter entitled, "Filters".

7. Mixing Boxes

Mixing boxes shall be of physical size to match the basic unit and include equal sized flanged openings, each sized to handle full air flow. Arrangement of openings shall be as indicated. Provide openings with dampers of opposed blade type. Al! damper shafts shall be connected together by one continuous linkage bar. Arrange dampers for manual operation so that when one starts to close from its opened position, the other starts to open from its closed position.

8. Controls

a) Condenser Controls

Provide load pressure control to insure condensing temperature for proper system operation at all ambient temperatures down to 40°F.

b) Condenser Start-up Control Provide condenser with a start-up control package which permits start-up compressor regardless of low ambient temperatures. Package shall temporarily bypass system low pressure-start to permit start-up whenever minimum ambient temperature is below design evaporator coil suction temperature.

9. Refrigerant Circuits

Entire refrigerant circuit shall be dehydrated, purged, and charged with refrigerant and oil at factory. Factory oil charge shall be the full amount required for operation. Factory charge for refrigerant shall be the full amount required for operation.

10. Corrosion Protection

Units shall be factory corrosion protected in accordance with paragraph entitled, Corrosion Prevention.

COOLING COILS

1. Direct-Expansion Coils

Direct-expansion coils shall be fin-and-tube type constructed of seamless copper or aluminum tubes and copper or aluminum fins mechanically bonded or soldered or helically wound to tubes. Casing and tube support sheets shall be not lighter than 16-gauge (0.0635-inch nominal thickness) galvanized steel, formed to provide structural strength. Suction header shall be seamless copper tubing or seamless or resistance welded steel tube with copper connection. Supply header shall consist of a distributor to distribute the refrigerant liquid through seamless copper tubing, equally to all the circuit in the coil. Tubes shall be circuited to insure minimum pressure drop and maximum heat transfer. Circulating shall permit refrigerant flew from liquid inlet to suction outlet without causing oil staging or restricting refrigerant flow in coil. Rack coil shall be tested at the factory under water at not less than 300 psi air pressure and shall be suitable for 200 psi working pressure. Each coil shall be completely dehydrated and scaled at the factory upon completion of pressure tests. Coil shall be mounted for counter flow service.

2. Filters

Filter shall be of the sectional or panel cleanable type and be capable of filtering the entire air supply.

3. Manometers

Provide inclined-type manometers for filter stations of 2,000 cfm capacity or larger including filters furnished as integral parts of air handling units and filters installed separately. Manometers shall be of sufficient length to read at least one inch of water column, shall be graduated in 1/10 inches, and equipped with spirit level. Equip each manometer with over-pressure safety traps to prevent loss of oil, and two three-way vent valves for checking zero setting.

CLEANING, PAINTING AND IDENTIFICATION

Cleaning, painting and identification of piping shall be as specified under, "Painting" of "Building Works".

IDENTIFICATION TAGS AND PLATES

Provide equipment, thermometers, valves, and controllers with tags numbered and stamped for their use. Plates and tags shall be of brass or suitable non-ferrous material, securely mounted or attached. Minimum letter and numeral size shall be 1/8 inch.

EXECUTION

INSTALLATION

Application and installation practices for unitary air-conditioning systems shall conform to the requirements of an acceptable industry standard for installation of unitary systems.

1. General

Install equipment and components in a manner to insure proper and sequential operation of the equipment and its controls. Installation of equipment not covered herein or in manufacturer's instructions shall be installed as recommended by manufacturer's representative. Provide proper foundations for mounting of equipment, accessories, appurtenances, piping and controls including, but not limited to, supported vibration isolators, stands, guides, anchors, clamps, and brackets. Foundations for equipment shall conform to equipment manufacturer's recommendation, unless otherwise shown in the drawings. Set anchor bolts and sleeves accurately using properly constructed templates. Anchor bolts shall be of adequate length and provided with welded-on plates on the head end embedded in