

**b. System Output**

- a. [VHF/[UHF receivers.
- b. FM receivers.

**4. System Performance****a. Receiver Termination Signal Level**

Each termination for a TV receiver must have a minimum signal level of 3 decibel mill volts (dBmV) (1,400 microvolts).

**b. Headend**

- 1) Visual carrier to noise ratio of the headend processor: 58 decibels (dB) at 10 dBmV input or 60 dB at maximum rated input.
- 2) Base band signal to noise ratio: 55 dB at optimum signal level.
- 3) Automatic gain control regulation of headend heterodyne processor and demodulator: plus or minus 2 dB.
- 4) Modulation linearity: 10 percent.
- 5) Modulation: 87.5 percent.
- 6) Undesired low frequency disturbance: 0.5 percent.
- 7) Spurious signals: must comply with 47 CFR 76 FCC Rules, 47 CFR 76.605, SUBPART A.
- 8) Differential gain: 1 dB.
- 9) Differential phase: 0.08726 rad.
- 10) Chrominance - luminance delay inequity: 150 nanoseconds.
- 11) Short time waveform distortion (K factor): 4 percent.

**c. Distribution System**

- 1) Modulation distortion at power frequencies: 4 percent or less hum distortion;
- 2) Composite third order distortion for:
  - a) CW carriers: 53 dB.
  - b) Modulated carriers: 59 dB.
- 3) Subscriber terminal isolation: 18 dB or greater.
- 4) Carrier to second order beat ratio: 60 dB.
- 5) Peak to valley frequency response (6 megahertz (MHz)): 2.3 dB.
- 6) Frequency response across video pass band of any channel: plus or minus 1 dB.

7) Visual, aural carrier level - 24-hour variation: 47 CFR 76 FCC 47 CFR 76.605 Rules 4, 5, and 6.

8) Frequency determination: 47 CFR 76 FCC 47 CFR 76.605,

#### SUBPART A Rules (1)(2)(3).

##### 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. Preamplifiers
- d. Splitters/combiners
- e. Multiplexers
- f. Amplifiers, including headend, 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 consist 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

## MAINTENANCE

### 1. Maintenance Data

Maintenance manual shall contain descriptions of maintenance for the overall MATV/CATV system as well as for the equipment. It shall include inspections, scheduling for and types of periodic preventive maintenance, fault diagnosis, troubleshooting techniques, and repair or replacement of defective components. It shall also include safety precautions for locking out hazardous energy sources.

## 2. Functional Design Data

Functional design manual shall identify the operational requirements of the system and explain the theory of operation, design philosophy, and specific function of each element of the system.

## 3. Hardware Data

Submit a hardware manual describing all equipment provided, including:

- a. General description and specifications.
- b. Installation and checkout procedures.
- c. Headend and system schematic diagrams.
- d. Electrical schematics and layout drawings.
- e. Alignment and calibration procedures.
- f. Manufacturer's repair parts list indicating sources of supply include national stock numbers.

## 4. Operator Data

Operator's manual shall provide procedures and instructions for operation of the system including:

- a. Types of alarms, meaning of alarms, and action to be taken.
- b. Preventive maintenance schedule.
- c. Local programming equipment].

## 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 which 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 overvoltage 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 ohms 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

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 aluminium 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.

#### c. CATV Housings/Pedestals

CATV housings/pedestals shall be weatherproof, sized as required, and shall 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. 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 deadend.

#### g. Grounding Block

Provide 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 millimeter. 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.

## 5. Wall taps

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

## LOCAL PROGRAMMING EQUIPMENT

### 1. Cameras

Two general purpose, color, black and white, cameras for studio classroom locations.

### 2. Lenses

General purpose lenses, millimeter (mm), f stop (f/) zoom lenses mm to mm, and f/; wide-angle lenses, mm, f/.

### 3. Digital Video Cassette Tape Recorders

Two front-loading desktop, rack-mounted, digital video cassette tape recorders.

### 4. Switcher

Input, /output, [desktop rack-mounted, bridging [terminating] switcher.

### 5. Fader

Input one/output, desktop recessed-in-the-table fader.

## SUPPORT EQUIPMENT

### 1. Matching Transformers

75-ohm female "F" fitting[s] connected to a 300-ohm spade tip matching transformer.

### 2. Band Separators

75-ohm female "F" fitting[s] connected to a VHF/UHF spade tip [and FM screw terminals] matching transformer with a band separator.

### 3. Coaxial Connector Cable

- a. 1830 mm, 75-ohm "F" fitting cable assembly.
- b. 3660 mm, 75-ohm "F" fitting cable assembly.
- c. 760 mm, 75-ohm "F" fitting cable assembly.

### 4. Coaxial Cable Connecting Kits

- d. 1830 mm, 75-ohm "F" fitting[s] connected to a 300-ohm spade tip matching transformer.
- e. 1830 mm, 75-ohm "F" fitting[s] connected to a 300-ohm VHF/UHF spade tip and FM screw terminals matching transformer with a band separator.



## 5. Converters

Set top converters equipped for output channel number 2, 3, 4 with 9, 18, 36, 58, 66 input channels.

## 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 the 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/mm<sup>2</sup> of surface.

##### e. Ladders, Obstruction Lights and Anticlimbing

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 anticlimb 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. Headend

Provide headend 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

(1) 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.]

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

(3) 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, handhole walls with corrosion resistant hardware.

(1) 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, handholes in accordance with Section 7.4, "Underground Electrical Works." The word "TELEPHONE" shall be cast in the top face of all new manholes, handhole covers. All manholes, handholes in streets must be rated AASHTO HB14 Class 20 wheel loading.

Attach the weatherproof housings containing the electronic equipment to the manhole, handhole wall with corrosion-resistant hardware.

(2) New Exterior conduit system: Provide a new conduit system constructed in accordance with Section Section 7.4, "Underground Electrical Works." The word "TELEPHONE" shall be cast in the top face of all new manholes, handhole covers. Attach the weatherproof housings containing the electronic equipment in new, Contractor-provided manholes, handholes. New manholes, handholes for such housings and equipment are not indicated on the drawings, but shall be provided. All manholes, handholes in the streets must be rated AASHTO HB Class 20 wheel loading.

(3) Exterior cable in exterior conduit: Do not bend cable more than the minimum radius recommended by the manufacturer, based on the type of sheath used. Connect cable conductors to the electronic equipment, and connect the shield to the housing. Provide subscriber service cable to the building, and terminate in a grounding block. Provide and connect grounding block to a grounding system, having a maximum 25 ohms resistance.

#### c. Direct Buried Cable

Provide buried cable in accordance with Section Section 7.4, "Underground Electrical Works." Provide CATV weatherproof housings/pedestals, handholes. The new housing/pedestals, handholes 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, handholes. 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 ohms 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-off's, 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 Pre-test

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. Preamplifier outputs.
- c. Headend 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. 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 27 : PUBLIC ADDRESS SYSTEM****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

2. Institute of Electrical and Electronics Engineers (IEEE)  
IEEE C62.41 (1991; R 1995) Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits

3. National Fire Protection Association (NFPA)

NFPA 70 (2007) National Electrical Code  
NFPA 72 (2002) National Fire Alarm Code

4. 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-preamplifier, 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.

##### 1. Identical Items

Items of the same classification shall be identical. This requirement includes equipment, modules, assemblies, parts, and components.

##### 2. Nameplates

Each major component of equipment shall have the manufacturer's name, address, model and catalogue number, and serial number on a plate secured to the equipment.

#### MIXER-PREAMPLIFIER (Optional)

Mixer-preamplifier shall as a minimum conform to the following specifications:

Rated Output: 18 dB

Frequency Response:	Plus or Minus 1 dB, 20 - 20,000 Hz
Distortion:	Less than 0.5 percent, 20 - 20,000 Hz
Signal to noise:	Microphone - 60 dB
Auxiliary:	70 dB
Inputs:	5-independent balanced low-impedance transformer-isolated
Input Sensitivity:	Microphone - 0.003 volts Auxiliary 0.125 volts Magnetic Cartridge - 0.0005 volts
Input Channel Isolation:	80 dB minimum
Tone Controls:	Plus or Minus 10 dB range at 50 and 15,000 Hz
Power Requirement:	220-240 Vac 60 Hz

#### POWER AMPLIFIERS

The power amplifier shall be provide with a nameplate indicating power rating to satisfy design, coverage, SPL requirements and reserve capacity requirements. Listed for Protective Signal Service and supervised in accordance with NFPA 72.

Power amplifiers as a minimum conform to the following specifications:

Rated power output:	60, 125, 250 watts RMS
Frequency Response:	Plus or Minus 3 dB, 20-20,000 Hz
Distortion:	Less than 2 percent at RPO, 600-13,000 Hz
Input Impedance:	50 k ohm unbalanced
Output Impedance:	Balanced 4 and 8 ohms
Output voltage:	25 and 70.7 volts
Power Requirement:	220-240 Vac 60 Hz

#### MIXER AMPLIFIER (Optional)

Mixer amplifier shall as a minimum conform to the following specifications:

Rated Power Output (RPO):	35, 60, 125 watts RMS
Frequency Response:	Plus or Minus 3 dB, 20-20,000 Hz
Distortion:	Less than 1% at RPO, 60 - 13,000 Hz
Inputs:	2 microphones (high impedance or low-impedance unbalanced) 2 Aux. (high-impedance)
Output Impedance:	Balanced 4 and 8 ohms



Output Voltage:	25 and 70.7 volts
Power Requirement:	220-240 Vac 60 Hz

## MICROPHONE INPUT MODULES

Microphone input modules shall as a minimum conform to the following specifications:

Rated Outputs:	0.25 volts into 10,000 ohms 1.0 volts into 10,000 ohms
Frequency Response:	Plus or Minus 2 dB, 20 - 20,000 Hz
Distortion:	Less than 0.5 percent 20 - 20,000 Hz
Inputs:	4 transformer - coupled balanced 150 ohm
Input Sensitivity:	0.003 volts
Input Channel Isolation:	70 dB minimum

## MICROPHONES

### 1. Desk Microphone

Microphones shall as a minimum conform to the following specifications:

Element:	Dynamic
Pattern:	Cardioid (Unidirectional)
Frequency Response:	50 - 12,000 Hz
Impedance:	Low impedance microphone (150-400 ohms)
Front to back Ratio:	20 dB
Selector switches:	Selector switches for zone shall be integral microphone or Separate console adjacent to microphone

### 2. Gooseneck Microphone

Gooseneck microphone shall meet the minimum requirements of the desk microphone. Microphone shall have push to talk button. Gooseneck tube length shall be [305] [406] mm.

### 3. Microphone Jack

Each outlet for microphones shall consist of a standard outlet box, flush-mounted, and fitted with a three-pole, polarized, locking-type, female microphone jack and a corrosion resistant-steel device plate.

## LOUDSPEAKERS

### 1. Cone Speaker

The cone speaker shall as a minimum conform to the following specifications:

Application:	Wall baffle, Ceiling
Frequency range:	60 to 12,000 Hz
Power Rating:	Normal - 7 watts Peak - 10 watts
Voice Coil Impedance:	8 ohms
Line Matching Transformer Type:	25/ 70.7 volt line
Capacity:	4 watts
Magnet:	10 ounces or greater
Primary Taps:	0.5, 1, 2 and 4 watts
Primary Impedance:	25 volts - 1250, 625, and 312 ohms 70.7 volts - 10k, 5k, and 2.5k ohms
Frequency Response:	30 - 20,000 Hz
Insertion Loss:	Less than 1 dB

### 2. Horn Speaker

The horn speaker shall as a minimum conform to the following specifications:

Application:	Indoor, Outdoor, and Weatherproof
Frequency Response:	400 - 14,000 Hz
Power Taps:	70 volt line - .9, 1.8, 3.8, 7.5, and 15 watts
Impedance:	5000, 2500, 1300, 670, 330, 90, & 45 ohms
Power Rating:	Normal - 7 watts Peak - 15 watts
Dispersion:	110 degrees

### 3. Dual Horn Speaker (Optional)

The dual horn speaker shall meet the minimum requirements of horn speaker except the dispersion shall be 100 degrees.

#### 4. High Output Speaker Enclosures (Optional)

High Output speaker enclosures shall be of the tuned-port design for precise balancing and tuning of the speaker. The enclosures shall be constructed throughout of 19.1 mm high density board, with screwed and glued joints, durably braced, and padded with fibreglass where acoustically required. Speaker enclosures shall have a 25, 45 degree vertical dispersion and 90, 120 degrees horizontal dispersion. The effective length of throw shall be a minimum of 15, 40, and 60 m.

#### 5. Wall Baffle Speaker Enclosures (Optional)

The wall baffle speaker shall be of particle board construction covered with walnut laminate and complete with black cloth grille. Baffle shall feature 9.5 degree slope to provide directional sound dispersion offset in the direction of radiation. Wall baffle enclosure shall come equipped with a wall mounting bracket designed to assure a rigid mounting to any flat surfaces.

#### 6. Ceiling Speaker Enclosures

Ceiling speaker enclosure shall be constructed of heavy gauge cold steel with interior undercoating and 38 mm thick high density fibreglass 24 kg per cubic meter. The unit shall be round, square and designed for recessed, surface installations which will be accomplished via standard screw torsion spring flange mounting. Recessed models shall have a rust-preventive, textured black coating and the surface mount unit finished in textured white. Enclosure shall include four triple compound conduit knockouts.

### SPEAKER SWITCHING PANEL

#### 1. Selector Switches

Zone control shall be provided for the paging function. The speaker switching panel shall contain at least double-pole, 4, 3 position push button selector switches and shall be rack-mounted, desk mounted, selector switches built in microphone to activate priority relays. Selector switches labelling shall be provided to identify the zones.

#### 2. System Power supply

Power supply shall be provided for priority relays and controls, rack mounted and sized for a capacity equal to 200 percent of the as-built control system, and shall operate at 24 Vdc. Input and output shall be protected to permit Class 2 wiring in accordance with NFPA 70.

### AM/FM EQUIPMENT (Optional)

#### 1. AM/FM Tuner

AM/FM tuner shall be rack-mounted and shall as a minimum conform to the following characteristics:

Tuning Range:	AM - 540 to 1605 kHz FM - 88 to 108 MHz
Selectivity:	60 dB on FM 40 dB on AM
Sensitivity:	FM - 1.5 micro volts AM - 2.0 micro volts

Capture Ratio:	1.0 dB
Readout/selection:	Digital
Other features:	Phased Lock Loop (PLL)
Power Requirement:	220-240 Vac, 60Hz

## 2. AM/FM Antenna

The AM/FM antenna shall be roof-mounted, either combined or suitable for both AM and FM reception or separate AM and FM antennas and shall cover all frequency bands specified for radio tuners. The antenna system shall be coordinated with the TV system and other systems with antenna communication. The system shall be furnished complete with a transformer, insulators, crossover insulator, cable of proper length, lightning arresters, coupling transformer and divider network at the radio tuners.

## COMPACT DISC/DVD PLAYER

Player shall have three beam laser pickup, dual Digital-to-Analog converters, random access and random mode programmable playback. [Player shall have capability to play a minimum of 5, 6 discs automatically. Player shall as a minimum conform to the following:

Frequency:	10 - 20,000 Hz Plus or Minus 1 dB
Signal-to-Noise:	Minimum of 100 dB
Dynamic Range:	Minimum of 96 dB
Total Harmonic Distortion:	Maximum of 0.005% at 1 KHZ
Channel Separation:	Minimum 100 dB at 1 KHZ
Quantization:	Minimum of 18 Bits Linear per channel
Conversion Rate:	Minimum 8 x Oversampling
Disc Size:	5 inch
Power Requirement:	220-240 Vac, 60Hz

## CASSETTE TAPE EQUIPMENT (Optional)

The [dual] cassette tape play deck shall as a minimum conform to the following specifications:

Frequency Response:	Plus or minus 3 dB, 20 - 20,000 Hz
Wow and Flutter:	Less than 0.09 percent WRMS
Signal-to-Noise:	74 dB
Noise Reduction system:	Dolby [B] [C] [S] [HX PRO]
Play Head:	Hard Parmalloy

Operation: Automatic Reverse

Power Requirement: 220-240 Vac, 60 Hz

## PRIORITY RELAYS AND CONTROLS

Priority relays and controls required to accomplish operations specified shall be provided. Relays shall be completely enclosed with a plastic dust cover for maximum protection against foreign matter, and shall be plug-in type. Relays shall be provided with a diode wired across the relay coil for transient suppression and shall be installed utilizing factory prewired, rack mounted receptacle strips. Coil shall be maximum 24 volts dc.

## 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 be jacketed 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 solderless, 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 labelled 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.

## TELEPHONE INTERFACE MODULE (Optional)

Telephone Interface Module shall provide one way all call paging access from telephone to PA system. Paging shall be accomplished by the building telephone system instruments interconnected to the PA system via an interface module to allow telephone dial up access to the paging amplifier. Interface module shall produce an alert tone in the associated speakers on activation. Telephone interface module shall as a minimum conform to the following specifications:

Impedance: 600 ohms

Frequency response: 100Hz to 10Khz

70V Input Impedance:	200K ohms
Output level:	400mV rms
Input Power Requirement:	12-24Vdc (from power supply)
Access requirement:	Electronic (analog) or IA2 line key (line card required) PABX loop or ground-start trunk port, or dedicated single-line phone.

## 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.



**ITEM 28 : 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 Fire Alarm Signalling Systems  
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 Signalling Devices for the Hearing Impaired  
UL 521 (1999; Rev thru Oct 2002) Heat Detectors for Fire Protective Signalling 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. Two (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:

- a) All building evacuation alarm devices Audio/visual alarm horns to operate continuously;
- b) 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:

- 1) Initiating circuits.
- 2) Evacuation alarm circuits
- 3) 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 signalling 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 centerline 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.

#### 1) Graphic Annunciator Panel (Optional)

Provide panel located as shown. Mount with panel centreline 1.5 m above finished floor elevation. Panel shall be of the interior type, surface-mounted. Panel shall be provided with the building floor plan, drawn to scale, with alarm lamps mounted to represent the location of each initiating device. Panel graphic shall also show the locations of the control panel, and shall have a "you are here" arrow showing its location. Orient building floor plan on graphic to location of person viewing the graphic, i.e. the direction the viewer is facing shall be toward the top of the graphic display. Provide a North arrow. Lamps shall illuminate upon activation of corresponding device and shall remain illuminated until the system is reset. Panel shall have a lamp test switch.

#### 2. Manual Pull Stations

Provide noncoded 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.

##### a. 4-Wire Smoke Detectors (Optional)

Detector circuits shall be of the 4-wire type whereby the detector operating power is transmitted over conductors separate from the initiating circuit. Provide a separate, fused, power circuit for each smoke detector initiating circuit (zone). Failure of the power circuit shall be indicated as a trouble condition on the corresponding initiating circuit.

**b. Photoelectric Detectors (Optional)**

Operate on the light scattering principle using a LED light source. Detector shall respond to both flaming and smoldering fires. Detectors shall be factory set for sensitivity and shall require no field adjustments of any kind. Detectors shall have an obscuration rating in accordance with UL 268.

**c. Detector Spacing and Location**

Detector spacing and location shall be in accordance with the manufacturer's recommendations and the requirements of NFPA 72, except provide at least two detectors in all rooms of 54 square meters or larger in area. In no case shall spacing exceed 9 by 9 m per detector, and 9 linear m per detector along corridors. Detectors shall not be placed closer than 0.9 m from any air discharge or return grille, nor closer than 300 mm to any part of any lighting fixture.

**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, NEC and NFPA 72. Wire for 240V circuits shall be 3.5 mm<sup>2</sup> minimum copper conductors. Wire for low voltage DC circuits shall be 2.0 mm<sup>2</sup> 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, NEC 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 turns 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.

**ITEM 29 : WIRE COMMUNICATION AND SIGNAL SYSTEM****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 (category 5).

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, shall 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 on 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.

**ITEM 30 : UNITARY AIR-CONDITIONING SYSTEMS****GENERAL**

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

**GENERAL REQUIREMENTS****1. Unitary 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 overstressing 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**

### **UNITARY 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 shall 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. All 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 flow 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 the concrete. Level equipment bases, using jacks or steel wedges, and neatly grouted-in with a non-shrinking type of grouting mortar. Locate equipment so that working space is available for all necessary servicing such as shaft removal, disassembling compressor cylinders and pistons, replacing or adjusting drives, motors, or shaft seals, access to water heads and valves of shell and tube equipment, tube cleaning or replacement, access to automatic controls, refrigerant charging, lubrication, oil draining and working clearance under overhead lines. Provide electric isolation between dissimilar metals for the purpose of minimizing galvanic corrosion.



## 2. Unitary Air-Conditioning System

Install system as indicated, in accordance with the requirements of ASHRAE 15-76 and as recommended in the manufacturer's installation and operational instructions.

## 3. Electrical Work

Electric motor driven equipment specified herein shall be provided complete with motors, motor starters, and controls. Electrical equipment and wiring shall be in accordance with Section 7.1, "Electrical General Requirements" of division 7. Motor starters shall be provided complete with properly sized thermal overload protection and other appurtenances necessary for the motor control wiring required for controls and devices but not indicated.

## 4. Piping

### a. Piping Sleeves

Pipe sleeves shall be as Galvanized Iron, Schedule 20.

### b. Provide refrigerant driers, sight glass liquid indicators, moisture indicators, and strainers in refrigerant piping for remote installations when not furnished by the manufacturer as part of the equipment.

### c. Locate strainers close to equipment they are to protect. Provide a strainer in the common refrigerant liquid supply to two or more thermal valves in parallel when each thermal valve has a built-in strainer. Install strainers with screen down and in direction of flow as indicated on strainers body.

### d. Solenoid valves shall be installed in horizontal lines with stem vertical and with flow in direction indicated on the valve. If not incorporated as internal part of the valve, provide strainers upstream of the solenoid valve. Provide service valves upstream of the solenoid valve, upstream of the strainer, and downstream of the solenoid valve. Remove the internal parts of the solenoid valve when brazing the valve.

## 5. Auxiliary Drain Pans, Drain Connections, and Drain Lines

Provide auxiliary drain pans under all drain pans of the units located above finished ceilings or over mechanical or electrical equipment where condensate overflow over unit drain pan may cause damage to ceilings, piping, and equipment below. Provide drain lines for all drain and auxiliary drain pans. Trap the drain from bottom pan of air-conditioning units to insure complete pan drainage. Drain lines shall be full size of opening.

## 6. Air Filters

Provide access panels for all concealed valves, controls, dampers, and other fittings requiring inspection and maintenance.

## 7. Inspection Plates and Test Holes

Inspection plates and test holes where required in casings for air balance measurements shall conform to SMACMA High Pressure Low Velocity Duct Construction Standards. Test holes shall be a factory-fabricated, air-tight, non-corrosive test hole with screw cap and gasket. Extend cap through insulation.

## 8. Flashing and Pitch Pockets

Provide flashing and pitch pockets for equipment support and roof penetrations and flashing where piping or ductwork passes through exterior walls.

## FIELD TESTS AND INSPECTIONS

### 1. Tests

All tests shall be performed and materials and equipment required for test shall be furnished by the Contractor. Tests after installation and prior to acceptance shall be performed in the presence of a representative of the Owner and subject to his approval. Equipment and material certified as having been successfully tested by the manufacturer in accordance with referenced specifications and standards will not require retesting before installation. Equipment and materials not tested at the place of manufacturer will be tested before or after installation, as applicable, where necessary to determine compliance with referenced specifications and standards.

### 2. Leak Testing

Upon completion of installation of the air-conditioning equipment, test all factories as well as field refrigerant piping with an electronic-type leak detector to acquire leak tight refrigerant systems. If leaks are detected at the time of installation or during the guarantee period, remove the entire refrigerant charge from the system, correct the leaks and retest the system.

### 3. Evacuation, Dehydration, and Charging

After system is found to be without leaks, evacuate the system using a reliable gauge and a vacuum pump capable of pulling a vacuum of at least 1 mm lig absolute. Evacuate system in strict compliance with the triple evacuation and blotter method or in strict accordance with equipment manufacturer's printed instructions. System leak testing, evacuation, dehydration, and charging with refrigerant shall comply with the requirement contained in an acceptable industry standard.

### 4. Start-Up and Operation Tests

The air-conditioning system and its components shall be started and initially placed under operation and checked to see that it is functioning correctly. Adjust safety and automatic control instruments as necessary to place them in proper operation and sequence. The operational test shall be not less than 8 hours.

### 5. Performance Tests

Upon completion of evacuation, charging, start-up, final leak testing, and proper adjustment of controls, the system shall be performance tested to demonstrate that it complies with the performance and capacity requirements of the specifications and plans. Test the system for not less than 8 hours, during which time hourly readings shall be recorded. At the end of the test period, the readings shall be averaged and the average shall be considered to be the system performance.

### 6. Sound Tests, Air-conditioners, Unitary, Split Type

Sound pressure level measurements shall be conducted on units designated by the Owner. Calculate sound power levels by ASHRAE Systems Handbook and Product Directory. Submit test results and calculations.

**ITEM 31 : WINDOW TYPE ROOM AIR CONDITIONING SYSTEMS****GENERAL**

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

**SCOPE OF WORK**

All Materials and equipment under this Division shall be furnished and installed by the Owner.

1. Furnish materials that are new and conform to the standards of organizations mentioned in the General Provisions.
2. The units shall be equal to that shown on the drawings with capacity not less than specified.
3. Provide electrical connections as required by the applicable codes.

**PRODUCTS****WINDOW TYPE ROOM AIR CONDITIONER**

The units shall be window type. Capacity rating and electrical characteristics shall be as indicated.

1. Energy Efficiency Ratio (EER) Submit data to demonstrate that the units will produce the efficiency rates specified.
  - a. Window Type Units: Units shall produce not less than 8.5 BTU's per hour cooling per watt-input for 230 volts AC units.
2. Exhaust Air

Provisions shall be made in the unit for controlled exhausting of room air and/or the controlled admittance of fresh air from the unit.
3. Unit Supports

Provide supports and mounts in accordance with manufacturer's recommendation or as indicated on drawings.
4. Corrosion Prevention

Treat units with a factory coating system as specified under paragraph entitled "Corrosion Prevention".
5. Condensate drain lines shall PVC conforming to ASTM D 2665. Insulate all condensate drain lines with 15 mm thick flexible elastomeric.

**EXECUTION****INSTALLATION**

1. Install system as indicated, in accordance with the requirements of ASHRAE 15-76 and as recommended in the manufacturer's installation and operational instruction.
2. Install the drain pipe and secure to the wall.
3. Upon completion of the system, the unit shall be tested to demonstrate that it complied with the performance and capacity requirements of the specification and drawings.
4. Read and record the power draw the refrigeration suction and liquid pressures as required for Balancing and Test.

**ITEM 32 : EXHAUST EQUIPMENT****GENERAL**

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

**SCOPE OF WORK**

1. Furnish materials that are new, of first-class quality.
2. Install all materials in strict accordance with the manufacturer's instructions and specifications.

**PRODUCTS****MATERIAL REQUIREMENTS****1. Ceiling Mounted Cassette Type Exhaust Fans**

The exhaust fans shall be of the built-in ceiling type, ceiling mounted, suitable for ducted operation. Sizes and capacities are based on KDK, NATIONAL models or approved equal. Brand and models indicated herein is for the purpose of establishing product quality, capacities and dimensions. Other brands satisfying the same shall likewise be accepted, subject to the approval of the owner and Engineer In-Charge. The capacities of the units shall be as shown on the Drawings.

**2. Wall Mounted Propeller Exhaust Fan**

The wall-mounted propeller exhaust fan shall be direct-drive three blade type with a steel mounting plate. Capacity of the fan shall be as shown on the drawings. Fan blades shall be constructed of steel or aluminum. The fan hub shall be of heavy construction and shall be of steel or semi-steel, and the blades shall be riveted to the hub. Fan blade shall be quiet in operation and shall be statically and dynamically balanced at the factory. Motor and Drive shall be of the condenser motor type, tightly sealed and dust proof with non-lubricating ball bearings. The fan shall be provided with automatic shutters to prevent air from re-entering the fan when fan is off. The fan control switch shall be located as near as possible to the fan.

**EXECUTION**

1. Install the fan securely to the ceiling.
2. Install back-draft dampers and check to make sure they are free to open and close.
3. Connect power and check rotation of fan.

**ITEM 33 : PROJECT BILLBOARD**

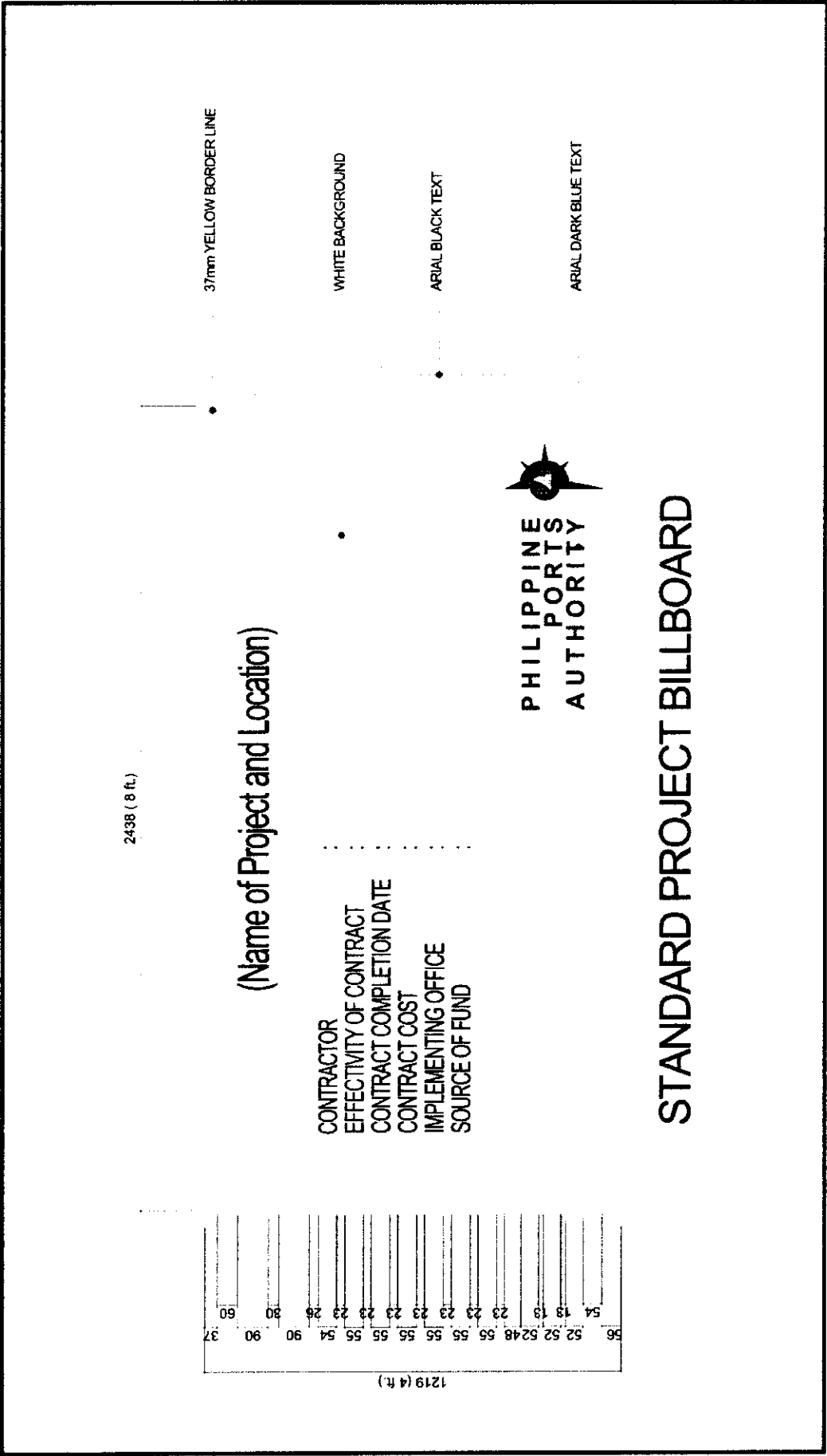
**SPECIFICATION**

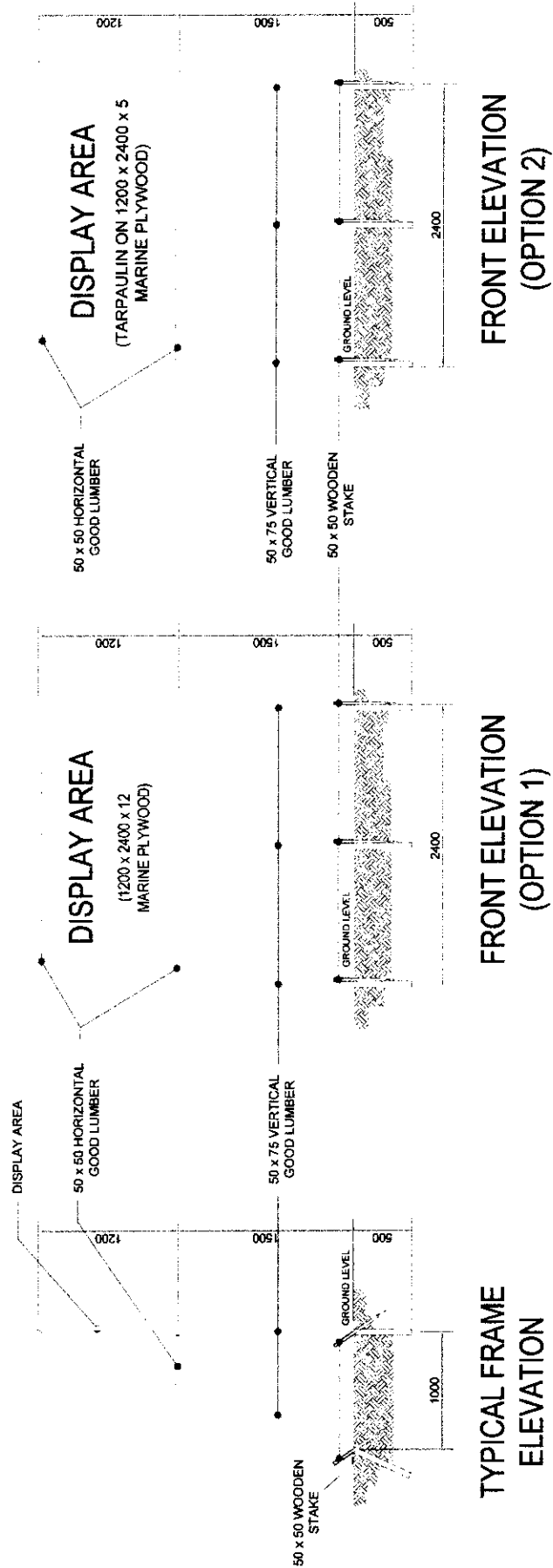
The Project Billboard shall be installed at location(s) designated by the Engineer.

The size and specifications of materials for the standard billboard shall be 4ft. x 8ft. (1,200mm x 2,400mm) using ½ inch (12mm) marine plywood or tarpaulin poster on 3/16 inch (5mm) marine plywood.

Project billboards shall not contain Name(s) and/or picture(s) of any personages.

See attached drawings for further details of the standard billboard.





## BILLBOARD FRAME

(NOT TO SCALE, ALL DIMENSIONS ARE IN MILLIMETERS)



## ITEM 34 : SAFETY SIGNAGES AND BARRICADES

### DESCRIPTION

This work includes the furnishing and installing of safety signages and barricades in accordance with the specifications and to the details shown below in the drawings, or as directed by the Engineer.

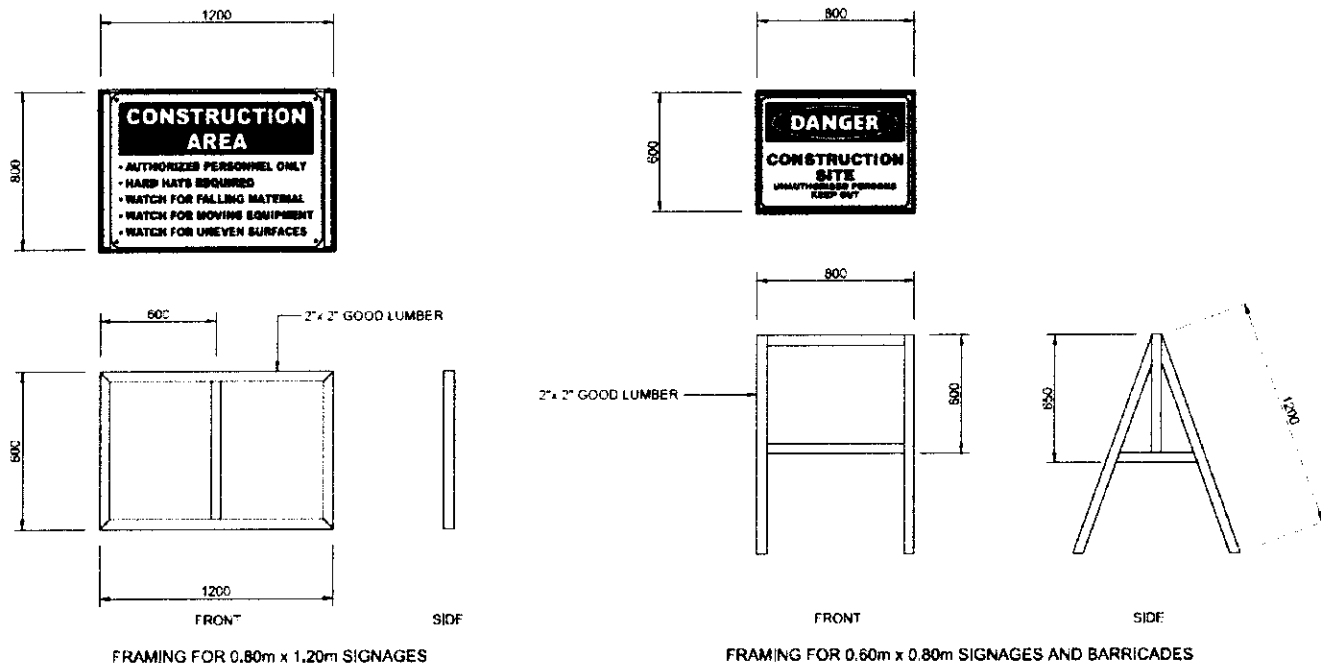
### SPECIFICATION

The Signage's and Barricades shall be installed at location(s) designated by the Engineer.

The sizes of the standard signages shall be 2-2/3ft x 4ft (800mm X 1,200mm) for fixed type and 2ft x 2-2/3ft (600mm x 800mm) for mobile type. For barricade standard 2ft x 2-2/3ft (600mm x 800mm) shall be provided.

The materials to be used for signages and barricades are ½ inch (12mm) marine plywood or tarpaulin poster on 2" x 2" (50mm x 50mm) good lumber frame (see drawing below).

The printing or painting shall be the discretion of the Engineer.



### STANDARD PLAN FOR SIGNAGES AND BARRICADES

**SECTION VII**

**PROJECT DRAWINGS**

**SECTION VIII**

**BILL OF QUANTITIES**  
**and**  
**ATTACHMENTS**

**BILL OF QUANTITIES**  
**CONSTRUCTION OF PPA PORT POLICE HEADQUARTERS**  
 South Harbor, Port Area, Manila



NO. (1)	DESCRIPTION OF WORK (2)	UNIT (3)	QTY. (4)	UNIT PRICE (Pesos) (5)	AMOUNT (Pesos) (4) x (5)
<b>BILL NO. 1</b>	<b>GENERAL EXPENSES</b>				
1.01	Mobilization, demobilization and cleaning	lot	1		
1.02	Provide Construction Safety and Health Program in the execution of the project	mo.	5		
<b>TOTAL FOR BILL NO. 1</b>					