

Special Specification 6017

Communications Hub Building



1. DESCRIPTION

Furnish and install Communications Hub Buildings as shown on the plans, as detailed in this Special Specification and as directed by the Engineer. Use these buildings to house the various surveillances and control equipment required for the system. Install and test each building upon completion of the work.

1.1. **Submittal Components.** As a minimum, the submittal for this Item completely addresses the following:

- Hub building shop drawing showing:
 - dimensions
 - doors
 - mounting channel
 - shelving
 - conduit routing
 - material list
 - exterior finish
 - door lock
 - door pin switches
- Power cable terminals
- RJ-11 voice communications jacks
- Terminal blocks
- Grounding
- Environmental parameters
- Wiring diagrams of all building panels
- Fan assembly and thermostat
- Air filter
- Light fixtures
- Building foundation drawing
- Power distribution panel
- Transient, surge and power line emi suppressors
- Circuit breakers

2. MATERIALS

Ensure overall floor dimensions of the structure are a minimum 6 ft. x 8 ft., or as required on the plans.

Ensure the suitability of the building for the equipment complement shown at each field location on the plans. Furnish and install if required, a larger size building fully at no additional cost. Other than size, ensure the selected building meets the requirements of this Specification and base mounted.

Components, back and side panels, terminal strips, harnesses, and connectors as well as mounting hardware necessary to provide for installation of equipment as described herein and on the plans. Ensure all electronic components comply with Special Specification Item, "Electronic Components."

Construct the building using unpainted sheet aluminum with a minimum thickness of 0.100 in. Design the building to withstand a 100 mph wind load. Ensure the exterior of the building is unpainted and the interior painted white.

Ensure all external screws, nuts and locking washers are stainless steel. Do not use self-tapping screws unless specifically approved by the Engineer. Ensure all parts are made of corrosion resistant material, such as plastic, stainless steel, aluminum or brass. Ensure all materials used in construction are resistant to fungus growth and moisture deterioration. Separate dissimilar metals by an inert dielectric material. Do not allow wood, wood fiber product, or flammable products in the building.

Ensure buildings conform to the requirements of ASTM B209 for 5052-H32 aluminum sheet.

Welds on aluminum buildings are to be done by using the gas metal arc (MIG) or gas tungsten arc (TIG) process using bare aluminum welding electrodes. Ensure electrodes conform to the requirements of the American Welding Society (AWS) A5.10 for ER5356 aluminum alloy bare welding electrodes.

Ensure procedures, welding machines and welding machine operators for welding on aluminum are qualified in accordance with the requirements of AWS B3.0, "Welding Procedures and Performance Qualification", and to the practices recommended in AWS C5.6.

Weatherproof the building to prevent the entry of water, dust and dirt. Seal all unwelded seams with a clear or aluminum-colored weather-seal compound.

Equip the building with shelves for supporting all shelf-mounted equipment as shown on the plans. Mount the shelves on unistrut or keyhole channels or equal. Provide shelves at least 10 in. deep in the building and a 1/2 in. clearance between the back of the shelf and wall. Support the shelves at least every 2 ft. of shelf length.

Equip each building with an open frame equipment rack for mounting EIA 19 in. rack mounted equipment. Provide the rack a minimum of 6 ft. of usable equipment mounting space. Provide the rack with mounting platforms to the building foundation with a minimum of 4 bolts. Equip the rack uprights with mounting holes drilled on EIA universal spacing and tapped with 10-32 threads. Ensure the racks are rust resistant and painted. Ground the rack to the building grounding system using a minimum of No. 6 AWG stranded cable. Mount two 12 outlet UL approved 15 ampere circuit breaker protected electrical outlet strips on the rack. Provide the outlet strips with AC power cords 12 ft. in length.

Ensure the building is tamper resistant and has a full size main door to allow entry while standing up. Equip the door with filtered vent openings. Brace the doors and hinges to withstand a 50 lb. per vertical foot of door height load applied vertically to the outer edge of the door when standing open. Ensure no permanent deformation or impairment of any part of the door or building body when the load is removed. Design provisions to hold the doors open at approximately the 90° and 180° positions.

Equip the door with a UL listed lock having the following features: A guard bolt which deadlocks the latch bolt, an inside knob which will always open the lock, and a toggle or other device on the inside which will prevent the outside knob from retracting the latch bolt. An example is the Sargent Function 05. Provide 2 keys for the lock. Provide a chain to limit the opening of the door. Ensure all buildings are keyed alike.

Provide a gasket to act as a permanent dust and weather resistant seal at the building door facings. Use a gasket material of a non-absorbent material to maintain its resiliency after long term exposure to the outdoor environment. The gasket has a minimum thickness of 3/8 in., and located in a channel provided for this purpose either on the building or on the door(s). A channel formed by an "L" bracket and the door lip is acceptable. In any case, the gasket must show no sign of rolling or sagging and must insure a uniform dust and weather resistant seal around the entire door facing. Any other method is subject to the Engineer's approval during inspection of an order.

Ensure the building is vented and cooled by a thermostatically controlled fan. The fan has a minimum capacity of 600 cu. ft. per minute.

The thermostat is an adjustable type with an adjustment range of 90°F to 135°F. Provide a press-to-test switch to test the operation of the fan.

Ensure the fan is a 12 in. commercially available model and designed to operate reliably over the temperature range of -30°F to 165°F. The intake for the vent system is filtered with a 16 in. (wide) by 25 in. (high) by 1 in. (thick) air conditioning filter. Securely mount the filter so that any air entering the building must pass through the filter. Screen the building opening for intake of air to prevent entry of insects and large enough to use the entire filter. Ensure the screen has openings no larger than 0.125 sq. in. Ensure the total free air opening of the vent is large enough to prevent excessive back pressure on the fan.

Mount one industrial type fluorescent light fixture with white porcelain enamel reflector and 4, 4 ft. fluorescent lamps in the building. Provide the light with an on-off switch. Position the light to provide illumination to all maintenance areas of the building.

Install one momentary pin-type door switch in the building or on the door. Wire the switch to a terminal block for the purpose of detecting a building intrusion condition by Satellite Control Center equipment.

Ensure the building foundation is included as part of this bid item. Mount the buildings on a concrete foundation as shown on the plans. Construct the cabinet foundation in accordance with Item 656, "Foundations for Traffic Control Devices". Ground the building to a 5/8 in. (minimum) copper clad ground rod 8 ft. long driven into the ground and installed in the foundation.

Provide the building with a unique 5 digit serial number which is stamped directly on the building or engraved on a metal or metalized mylar plate epoxied or riveted with aluminum rivets to the building. The digits are at least 0.2 in. in height and located on the upper right side wall near the front of the building.

Submit details of the building to the Engineer for review and approval prior to fabrication.

Submit a building layout for each building location for approval by the Engineer. Only buildings with an approved layout are accepted under this project.

Ensure the equipment, design, and construction uses the latest available techniques with a minimum number of different parts, subassemblies, circuits, cards and modules to maximize standardization and commonality.

Design the equipment for ease of maintenance. Ensure all component parts are readily accessible for inspection and maintenance.

2.1. **Electrical Requirements.**

2.1.1. **Distribution Panel.** Furnish the buildings with a U.L. listed single phase, 3 wire, 120/240, 100 ampere main circuit breaker, 12 circuit indoor surface mounted power distribution panel mounted on the inside wall of the building. Provide a detailed layout for approval by the Engineer. Ensure the panel is Square D QO series or equal. Install all wiring as per National Electrical Code.

2.1.1.1. **Receptacles.** Install receptacles as shown on the plans. Ensure all receptacles have circuit breaker protection. Ensure electronic equipment receptacles are NEMA type 5-20R or as required to match electronic equipment plugs. Convenience outlets are NEMA type 5-20R and have Ground Fault Circuit Interrupter protection.

2.1.1.2. **Circuit Breakers.** Install circuit breakers as shown on the plans. Provide circuit breakers from the same manufacturer as the distribution panel. Ensure all spare breaker spaces have 20 ampere breakers installed.

Circuit breakers must be unaffected by ambient temperature range, relative humidity, applied power, shock and vibration range specified in Section 2, "Environmental Standards and Test Procedures", of NEMA TS1-1989, latest revision. Ensure circuit breakers have an interrupt capacity of 10,000 amperes and insulation resistance of 100 Megs at 500 VDC. Equip the circuit breakers with solderless connectors and install in such a manner that their rating markings are visible and easily accessible.

The above breakers are in addition to any auxiliary fuses which may be furnished with the electronic equipment to protect component parts. Protect the load side of all circuit breakers by an EDCO Model SHP-300-10S or equivalent 3 terminal lightning arrestor. Use number 8 AWG or larger stranded copper conductors to connect the arrestor into the circuit. Connect the arrestor to the line filter as recommended by the manufacturer.

2.1.1.3. **Radio Interference Suppressor.** Equip all buildings with a radio interference suppressor installed on the load side of each electronic equipment circuit breaker. Provide the suppressor with a minimum attenuation of 50 decibels over a frequency range of 200 kilohertz to 75 megahertz. Hermetically seal the suppressor in a substantial metal case, and then fill with a suitable insulation compound. Ensure the suppressor terminals are nickel plated brass studs of sufficient external length to provide space for connection of 2 appropriately sized conductors and mounted so that the terminals cannot be turned in the case. Design the suppressors for operation at the proper current rating as determined by the Contractor per the plans. Design the suppressors for 120 volts, 60 hertz, operating and approved by UL and EIA.

2.1.1.4. **Power Line Surge Protection.** Install power line surge protectors in each building between the line conductors and ground. Provide and install power line surge protectors as described herein.

Provide one surge protector with a 3 electrode gas tube type and that has the following ratings:

- Impulse Breakdown: Less than 1,000 volts in less than 0.1 microseconds at 10 Kilovolts/microsecond.
- Standby Current: Less than 1 milliampere.
- Striking Voltage: Limit any voltage greater than 212 VDC.
- Capable of withstanding 15 pulses of peak current, each of which will rise in 8 microseconds and fall in 20 microseconds to 1/2 the peak voltage, at 3 minute intervals. Peak current rating must be 20,000 amperes.

Ensure the surge protector uses both metal oxide varistors and silicon avalanche diodes to protect against transients having a single surge energy level up to 70 joules, voltage transients up to 6 kv and current transients up to 6 kA. Provide protection for line to neutral, line to ground and neutral to ground terminals.

Provide the protectors with the following ratings:

- Recurrent peak voltage - 212 volts.
- Energy rating minimum - 120 joules.
- Power dissipation - average 0.85 watts.
- Peak current for pulses of less than 6 microseconds - 20,000 amperes.
- Standby current - less than 1 milliampere.

2.1.1.5. **Power Cable Input Junction Terminals.** Provide a barrier terminal block with a minimum of 2 terminals and 1 compression fitting designed to accept up to a No. 2 AWG stranded wire for the power supply lines. Rate the block at 100 amperes and ensure double binder head screw terminals.

Electrically isolate the AC neutral and equipment ground wiring from the line wiring by an insulation resistance of at least 10 megohms when measured at the AC neutral. Color code the AC neutral and equipment grounding wiring white and green, respectively.

2.1.2. **Loop Input Distribution Panel.** Include in each building a fully wired loop input distribution panel to be mounted on the inside wall of the building. Provide a detailed layout for approval by the Engineer. This panel includes the following components:

2.1.2.1. **Power Distribution.** If any 120 volts AC power is needed for the loop input distribution panel, use the power distribution panel described in Article 4.A. "Distribution Panel".

2.1.2.2. **Loop Surge Protection.** Mount the surge protection for incoming loop pairs on the loop input distribution panel.

- 2.1.3. **Back Panel.** Include in each building a fully wired equipment panels to be mounted on the inside wall of the building. Provide a detailed layout for approval by the Engineer.

Use the back panels to distribute and properly interconnect all building wiring related to the specific complement of equipment called out on the plans. Terminate the cable harness at each item of equipment including any furnished by the Department at terminal boards on the back panel. Ensure all functions available at the equipment connector carries in the connector cable harness to the terminal blocks from the power distribution panel.

Install Voice Communications jacks as required on the plans. Install an RJ-11 modular telephone jack on the back panel and connect it to the voice communication circuit of the communications system. Install a phone jack compatible with the emergency voice communication equipment on the back panel and connect it to the emergency voice communications circuit.

- 2.1.4. **Wiring.** Ensure the building is fully wired and all wiring within the building are neatly wrapped and routed such that opening and closing the door or raising or lowering the back panel will not twist or crimp the wiring. Ensure no cable pressure points are present.

Cut all wires to the proper length before assembly. Ensure no wires are doubled back to take up slack. Ensure harnesses to connectors are covered with PVC sheathing, woven braid or braided. Secure cables with nylon cable clamps.

Provide cable slack to facilitate removal and replacement of assemblies, panels and modules.

Ensure all harnesses and wiring are color coded. In addition, ensure each wire in every harness is hot-stamped every 4 in. with a number indicating the pin number of the connector that the wire is connected to. Ensure harnesses with connectors with pins identified by letters are stamped with numbers that correspond to the alphabetic sequence of the pins. Ensure each harness is cross-referenced to a chart on the building print that lists the connector pin letter or number, the wire number, the terminal number that the wire is connected to and the function of the wire. Ensure each harness is enclosed in PVC sheathing, woven braid or braided. Ensure individual conductors in detector harnesses are exempt from the requirements for hot-stamping. Tie wraps, tape or other cable ties are not acceptable.

Ensure all electrical connections in the building, including relays, flashers, terminal strips, etc., have sufficient clearance between each terminal and the building to provide an adequate distance to prevent a leakage path or physical contact under stress. Ensure all equipment grounds run directly and independently to the ground bus. The lay of the interconnect cable between the components must be such that when the door is closed, it does not press against the cables or force the cables against the various components inside the buildings. Provide sufficient length of cable to easily reach the electronic equipment placed anywhere on the shelves.

Route and bundle all wiring containing line voltage AC separately and/or shielded from all low voltage, i.e., control circuits. Cover all conductors and live terminals or parts, which could be hazardous to maintenance personnel, with suitable insulating material.

Ensure all conductors used on the building wiring are stranded No. 22 AWG or larger. Ensure conductors conform to MIL SPEC MIL-W-168780, Type B or D. Ensure the insulation has a minimum thickness of 10 mils. Ensure all wiring containing line voltage is a minimum size of No. 14 AWG.

Ensure all AC service lines are of sufficient size to carry the maximum current of the circuit or circuits they are provided for. Ensure conductors for AC common are white; conductors for equipment ground are green and all other conductors color different than the foregoing.

Use grounding conductors in all electrical circuits and do not rely on conduit as sole means of grounding. Ensure the ground conductor is sized according to the NEC and has green insulation.

- 2.1.5. **Terminal Blocks.** Provide terminal blocks located on the panels accessible to the extent that it will not be necessary to remove the electronic equipment from the cabinet to make an inspection or connection.

Ensure terminal blocks are 2-position, multiple pole barrier type. Provide shorting bars in each of the positions provided along with an integral marking strip. Arrange terminal blocks so that they do not upset the entrance, training and connection of incoming field conductors. Identify all terminals suitably by legends permanently affixed and attached to the terminal blocks. Ensure not more than 3 conductors is brought to any 1 terminal screw. Ensure no electrically energized components or connectors extend beyond the protection afforded by the barriers. Locate all terminal blocks below the shelves. Ensure terminals used for field connections are secure conductors by means of a No. 10-32 nickel or cadmium plated brass binder head screw. Ensure terminals used for interwiring connections, but not for field connections, are secure conductors by means of a No. 6-32 nickel plated brass binder head screw.

As a minimum, all connections to and from the electronic equipment must terminate to an interwiring type block. These blocks will act as intermediate connection points for all electronic Input/Output.

Permanently identify all terminals in accordance with the building wiring diagram. Where through-panel solder lugs or other suitable connectors are used, permanently attach both sides of the panel as close to the terminal strip as possible and do not affix to any part which is easily removable from the terminal block panel.

Provide and equip detector harnesses with connectors compatible with loop amplifiers used on project. Protect each loop pair by an EDCO Model SRA-16C or Davis Engineering Model DE320 or equivalent surge arrester.

Connection of the detector lead-in cable to the detector terminal blocks must be accomplished in the following manner: Properly dress each cable into position in accordance with the approved lead-in cable position on the panel (bundle the cables together and broken out by their position on the terminal boards). Bring the cable as close to the terminal points as possible and leave floating. Ground the cable shield after testing and in accordance with the loop detector manufacturer's specifications.

- 2.1.6. **Solid State Load Switches.** Ensure the load switches are solid state and have no moving parts. Ensure the load switches meet the requirements set forth in Section 5 of NEMA Standard TS1-1989, latest revision, and are "triple signals load switch" type. Provide an indicator light for each circuit on each load switch. Keep the indicator light on when a true input to the load switch is present. Ensure the load switches are capable of operation at 10 amperes of tungsten lamp load over the specified temperature range.
- 2.1.7. **Building Internal Grounding.** The building internal ground consists of 1 or more ground bus-bars permanently affixed to the building and connected to the grounding electrode. Use bare stranded No. 1/0 AWG copper wire between the bus-bars and between bus-bar and grounding electrode. Ensure each copper ground bus-bar has a minimum of 20 connector points, each capable of securing at least 1 No. 10 AWG conductor. Return AC neutral and equipment ground wiring to these bus-bars.
- 2.1.8. **Transient Suppression.** Place transient suppression devices on the coil side of all relays in the building. Ensure DC relay coils has, as a minimum, a reverse biased diode across the coil. Ensure AC relays has MOV's or equivalent suppression across their coils.
- 2.1.9. **Surge Protection.**
- 2.1.9.1. **Protector and Building Configuration.** Provide all ungrounded conductor wires entering or leaving the building with surge protectors. Keep the conductor leads and the surge protector leads as short as possible with all conductor bends formed to the maximum possible radius. Locate the protector units as near as possible to the entry or exit point, and as far as possible from any electrical equipment. Connect the protector ground lead directly to the ground bus.
- Ensure the surge protector used for AC power does not dissipate any energy and does not provide any series impedance during standby operation. Return the unit to its non-shunting mode after the passage of any surge and do not allow the shunting of AC power.
- 2.1.9.2. **Signal Head Lamp Wires.** Provide all signal light interconnect conductors with surge protectors in the building. Ensure the surge protector has the same characteristics as that specified in Section 4.A.4 of this Specification.

- 2.1.9.3. **Vehicle Detector Loop Lead-In.** Provide each vehicle detector lead-in cable with surge protection. In addition, connect the drain wire of the lead-in cable to the building ground bus.
- 2.1.9.4. **Signal Wires.** Ensure each signal wire entering or leaving the building has 2 stage surge protection with the following characteristics:
- Protector must have input, output and ground connections;
 - Peak surge handling capability: 4,000 amps, 8 X 20 microsecond waveform;
 - Protector life: Must withstand a minimum of fifty 2,000 amp, 8 X 20 waveform surges.
 - Response time: Calculated element speed of 1 X 10-12 seconds, measured speed of less than 20 nanoseconds.
 - Protector clamp voltage: Specified by the Contractor so as to be consistent with the equipment being protected and submitted to the Engineer for approval.
- 2.1.10. **Environmental Design Requirements.**
- Ensure the buildings meet all of its functional requirements during and after subsection to any combination of the following requirements:
- 2.1.10.1. Ambient temperature range of 0°F to 158°F.
- 2.1.10.2. Temperature shock not to exceed 30°F per hour, during which the relative humidity shall not exceed 95%.
- 2.1.10.3. Relative humidity range not to exceed 95% over the temperature range of 40°F to 110°F.
- 2.1.10.4. Moisture condensation on all surfaces caused by temperature changes.
- 2.1.11. Testing, Training, Documentation, Final Acceptance and Warranty
- 2.1.12. Testing of the Communications Hub Building complies with Article 2. of Special Specification, "Testing, Training, Documentation, Final Acceptance, and Warranty".
- Documentation for the Communications Hub Building complies with Article 4. of Special Specification "Testing, Training, Documentation, Final Acceptance and Warranty".
- Warranty for the Communications Hub Building complies with Article 6. of Special Specification, "Testing, Training, Documentation, Final Acceptance and Warranty".

3. MEASUREMENT

This Item will be measured as each unit furnished, installed and tested in accordance with this Special Specification.

4. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" are paid for at the unit price bid for "Communications Hub Building". This price is full compensation for all equipment described under this Item with all cables and connectors, building foundation, documentation and testing, and for furnishing all labor, materials, training, equipment, and incidentals.