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**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

**NASA/KSC-27 11 00.00 98 (July 2020)**

**Preparing Activity: NASA**

**Superseding**
**NASA/KSC-27 11 00.00 98 (November 2014)**

**UNIFIED FACILITIES GUIDE SPECIFICATIONS**

**References are in agreement with UMRL dated July 2023**

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SECTION 27 11 00.00 98

COMMUNICATIONS EQUIPMENT ROOM FITTINGS
**07/20**

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**NOTE: This specification covers the requirements for Communication/Equipment Room and Entrance Facilities.**

**Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable items(s) or insert appropriate information.**

**Remove information and requirements not required in respective project, whether or not brackets are present.**

**Recommended changes to a NASAKSC Master Specification Section should be submitted as a Criteria Change Request (CCR) to the appropriate Technical Proponent (TP) through the SpecsIntact Help Desk.**

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## PART 1 GENERAL

### 1.1 REFERENCES

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**NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.**

**Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the**

**Reference Wizard's Check Reference feature to update the issue dates.**

**References not used in the text are automatically deleted from this section of the project specification when you choose to reconcile references in the publish print process.**

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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.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE 802.3 | (2022) Ethernet |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| IEC 60603-7 | (2011) Connectors for Frequencies Below 3 MHz For Use With Printed Boards - Part 7: Detail Specification for Connectors, 8-Way, Including Fixed and Free Connectors With Common Mating Features, With Assessed Quality |
| KSC-SPEC-E-0012 | (1968) Specification for Heat and Blast Protection coating Materials for Electrical Cables |
| NFPA 70 | (2023) National Electrical Code |
| NFPA 780 | (2023) Standard for the Installation of Lightning Protection Systems |

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

| | |
|---|---|
| TIA-568-C.1 | (2009; Add 2 2011; Add 1 2012) Commercial Building Telecommunications Cabling Standard |
| TIA-606 | (2021d) Administration Standard for Telecommunications Infrastructure |

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

| | |
|---|---|
| FCC Part 68 | Connection of Terminal Equipment to the Telephone Network (47 CFR 68) |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 497 | (2001; Reprint Jul 2022) UL Standard for Safety Protectors for Paired Conductor Communication Circuits |

## 1.2 SUBMITTALS

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**NOTE: Review Submittal Description (SD) definitions**

**in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project.**

**A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.**

**An "S" following a submittal item indicates that the submittal is required for the Sustainability Notebook to fulfill federally mandated sustainable requirements in accordance with Section 01 33 29 SUSTAINABILITY REPORTING.**

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Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Floor Plans[; G]

Front Elevations[; G]

SD-03 Product Data

Entrance Facility Terminals[; G]

Surge Protection Modules[; G]

Distribution Frames[; G]

Floor Mounted Equipment Racks[; G]

Floor Mounted Equipment Racks and Cabinets[; G]

Wall Mounted Equipment Cabinets[; G]

Wall Mounted Equipment Racks[; G]

Cable Management[; G]

Patch Panels[; G]

Fiber Optic Panels[; G]

Grounding Bars[; G]

110 System Blocks[; G]

Patch Cords[; G]

UTP Cross Connects[; G]

Backboards[; G]

Cable Tray[; G]

SD-07 Certificates

Test Meter

SD-11 Closeout Submittals

Record Drawings[; G]

1.3 QUALITY CONTROL

Provide equipment and materials per [construction drawings] [Bill of Materials] or approved equal. Meet specified separation from sources of Electromagnetic Interference (EMI).

Provide the communication grounding and bonding in accordance with applicable Codes and regulations, conforming to KSC-SPEC-E-0012 and NFPA 780. Meet the requirements of NFPA 70 for grounding throughout the entire cabling system.

1.4 GENERAL NOTES1.4.1 Specification Override

This section overrides any conflicting SpecsIntact specifications.

1.4.2 UTP/STP Testing

Test all comm UTP/STP (unshielded twisted pair/shielded twisted pair) cables using a Fluke Model DSX-5000 or NASA approved equal. Test the horizontal UTP/STP cables terminating in patch panels to the IEEE 802.3 10GBASE-T Permanent Link Specification. Test UTP/STP cable terminations on insulation displacement connection (IDC) disconnect blocks to the TIA-568-C.1 Category 6 permanent link specification.

1.4.3 UTP/STP Test Results

Deliver Comm UTP/STP cable test results electronically to NASA KSC in Linkware machine readable format.

1.4.4 Test Meter

Submit the test meter serial numbers (main and remote units), software version and calibration date to the Contracting Officer for approval before testing any horizontal wiring.

1.4.5 NASA KSC Provisions

Comm cabling, faceplate, patch panel, IDC block and cabinet labeling is provided by NASA KSC Comm personnel.

1.4.6 Component Approval

Obtain NASA KSC Comm Personnel pre-approval on all horizontal wiring components (cable, patch panels, jacks and intermediate distribution frame (IDF) blocks). NASA KSC comm personnel will provide a list of qualified components upon request.

1.4.7 Customer Face Plate (CFP)

Ensure the standard customer facing faceplate (CFP - customer face plate) contains 2 each 10GBASE-T horizontal links terminating in separate patch panels.

1.4.8 Chatsworth Products Inc (CPI)

The NASA KSC standard telecommunications cabinet is the CPI (Chatsworth Products Inc) M series cabinet.

1.4.9 Color Coded Wiring

Use the following color codes for wiring:

| DESCRIPTION | COLOR |
|---|---|
| Date Premise Wiring | Blue |
| Wireless Access Points | Orange |
| Paging | Yellow |
| Security Cameras | Green |
| Horizontal Wiring | Blue |
| Auxiliary Circuits - Alarm, Security | Yellow |
| Future use and Key Systems | Red |
| Inter-building Campus Backbone | Brown |

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Minimum requirements for entrance equipment, termination hardware, and cable installations in main communication equipment rooms and communication rooms/closets contain the following:

a. Entrance Facility (EF) Terminals

b. Surge Protection Modules

c. Wall Mounted Distribution Frames

d. Ladder Racking/Cable Tray

e. Grounding and Bonding Provisions

f. Backboards

g. Frame Mounted Termination Blocks and Rings

h. Cross Connects

2.1.1 Design Requirements

2.1.1.1 Preliminary Drawings

Submit preliminary drawings prior to the start of work for the following: (Obtain electronic files of the building floor plans from the Contracting Officer.)

a. Scaled 1:50 1/4-inch by 1-foot Communication Room floor plans showing the planned location of all installed components.

b. Front elevations of a typical patch panel for each system.

2.1.1.2 Environmental System

Provide connecting hardware rated for operation under ambient conditions of 0 to 60 degrees C 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, non-condensing.

2.2 EQUIPMENT

2.2.1 Entrance Facilities

2.2.1.1 Entrance Facility Terminals

Protect all lines (pairs) through entrance facility terminal. Input stub (tip) cable required is [26][Sized by NASA] AWG shielded cable. Verify actual stub length in field. Equip input stub with a heavy-duty strain relief and encapsulated cable connector. Serve input stub as internal fuse link. The output stub cable required is 24 AWG shielded cable. Field verify actual stub length. Provide 5 pin protection modules, wall or frame mountable, for entrance facility terminals. Meet or exceed requirements of UL 497 for plastic components.

2.2.1.2 Surge Protection Modules

Provide true balance operation, 5 pin, 3 element gas type surge protection modules. Provide surge modules that ionize the entire tube through over-voltage on either side to provide a simultaneous path to ground for both sides of the circuit. Provide surge protection modules that have UL 497 certification. Provide a tin-plated ground pin, gold alloy ring pins, and color black module. Provide a color green surge protection module for spare pair modules. Use 350V at 100V/microsecond for the nominal DC breakdown. Use 700A at 100V/microsecond and 150A at 1KV/microsecond for the impulse breakdown voltage.

For the surge protection modules DC holding current, use 135V for less than 150millisecond (ms). The surge protection modules surge life (min. operations) required is as follows:

At 10A, 10 by 1000 microseconds

Use less than 1pf capacitance, for 1 Vrms at 1Khz, 50 DCV. Use greater than 100M ohms at 50 VDC for the insulation resistance. The fail safe operation required is as follows:

| | |
|---|---|
| At 1.0A | less than 50 sec |
| At 5.0A | less than 15 sec |

At 20A less than 10 sec

At 60A less than 3 sec

The current limiters required are as follows:

hold current (ma) at 20 C equals 145

R min / max ohms equals 3/6

2.2.1.3 Floor Mounted Frames for Protection Terminals

Provide 2.1 m 84-inch high frames suitable for single side mounting of protection terminals. Ensure the overall width of the frame 0.9 m is [35.5] [_____] inches and the depth 381 mm [15] [_____] inches. Supply the frame with 305 mm 12-inch cable runway support, junctioning bolts, aluminum bond bars, grounding screws and screws for installing the blocks. Provide 153 mm 6-inch vertical channel to feed cables to blocks for floor mounted frames for protection terminals. Provide the lowest installed block at 153 mm 6-inch above finished floor (AFF).

2.2.1.4 Floor Mounted Distribution Frames

Provide 2.1 m 84-inch high frames suitable for single side mounting of 110 termination blocks. Configure the frame to support the number of pairs indicated on the drawings. Ensure the overall width of frame 953 m is [37.5][_____] inches and the depth 409 mm [16.13] [_____] inches. Supply the frame with 305 mm: 12-inch cable runway support, junctioning bolts, bond bars, grounding screws and screws for installing the blocks. Divide frame into two modules. Construct top module to support six (6) 110 blocks and bottom module to support nine (9) 110 blocks, with the lowest installed block at 18-inches AFF. Provide racks with 153 mm a 6-inch vertical channel to feed cables to blocks.

2.2.1.5 Steel Ladder Racking/Cable Tray

Provide ladder rack/cable tray in equipment room, as shown on drawings for backbone cable support. Provide connecting and support hardware to suit installation, including but not limited to, racks, runway mount plates, wall angle support brackets, butt splice swivels, connect junctions and grounding kit.

2.2.1.6 Grounding and Bonding

Provide grounding bar assembly and a minimum No. 2 grounding electrode conductor from the ground bar to a suitable electrical building ground. Label grounding and bonding hardware and connections per TIA-606. Appropriately bond the grounding wire to the grounding bar and electrical building ground. Construct ground bar assembly with the following materials (see drawing details for additional information):

a. Copper ground bar 6 mm by 102 mm by 305 mm 1/4-inch by 4-inch by 12-inch with 7 mm 9/32-inch holes spaced 32 mm 1-1/8-inch apart.

b. Stand-off insulators.

c. Lockwashers.

d. Wall mounting brackets.

2.2.1.7 Backboards

Provide 1.2 m by 2.4 m by 19 mm 4-foot by 8-foot by 3/4-inch ACX or CDX, fire rated plywood backboards or as indicated on the drawings. Paint backboards with gray, acrylic, interior grade, fire-retardant paint.

Install open end distribution rings above all wall mounted blocks for wall mounted cross-connect fields, two rings per vertical row.

2.2.1.8 Termination Blocks on Frame

Provide blocks that are 110 style 300 pair blocks. Provide connecting clip, designation strip, plastic covers and retaining clip necessary to terminate cables.

2.2.1.9 UTP Cross Connects

Provide same gauge (22 AWG and 24 AWG) of cross connect wire as the feed cable to which it is being connected. For circuit connections use 24 AWG single twisted pair and dual twisted pair wire as required. Rate conductors a minimum of TIA-568-C.1 Category 6 or better. Provide cross connect wires of the following colors:

| DESCRIPTION | COLOR |
|---|---|
| Voice Circuits | White-Blue |
| Fire Alarm | White-Red |
| Temporary Circuits | White-Black |
| 4 Wire Services | Solid Colored White-Blue-Red-Green |

2.2.2 Communications/Equipment Rooms

2.2.2.1 Floor Mounted Equipment Racks

Required physical specifications of racks are as follows:

a. 483 mm 19-inch rack mounting space.

b. 2.1 m 7-foot - 0-inch tall.

c. Lightweight, high strength aluminum construction.

d. Black powder coat finish.

e. 381 mm 15-inch deep base with four (4) 19 mm 3/4-inch bolt down holes.

f. EIA Channel width of 76 mm 3.0-inch, with No. 12-24 screw holes.

Provide racks with double sided 12/24 tapped holes and EIA universal rack 16 mm to 13 mm 5/8-inch to 1/2-inch standard hole pattern (compatible with 32 mm to 13 mm 1-1/4-inch to 1/2-inch hole patterns).

2.2.2.2 Wall Mounted Equipment Racks

Required physical specifications of wall mounted equipment racks are as follows:

a. 483 mm 19-inch rack mounting space.

b. 1.2 m 48-inch high with 24 mounting spaces.

c. Lightweight, high strength steel construction.

d. Black powder coat finish.

e. Stationary mounting with 533 mm 21-inch deep, 14 gauge mounting brackets and 45 kg 100 lb. capacity.

f. Provide racks with double sides EIA universal rack 16 mm to 13 mm 5/8-inch to 1/2-inchstandard hole pattern, (compatible with 32 mm to 13 mm 1-1/4-inch to 1/2-inch hole patterns).

2.2.2.3 Wall Mounted Equipment Cabinets

Provide wall mounted equipment cabinets that meet the following specifications:

a. 483 mm 19-inch equipment mounting space.

b. 1.2 m 48-inch high with 26 rack mount spaces.

c. Universal mounting rails with 10/32 and 12/24 tapped holes.

d. 16 mm to 13 mm 5/8-inch to 1/2-inch EIA standard hole pattern.

e. Black powder coat finish.

Provide cabinets with a two-hinge lockable front and rear access, with louvered sides for ventilation, and knockouts in top and bottom for cable access.

2.2.2.4 Floor Mounted Cabinet

Provide floor mounted cabinets that meet the following specifications:

a. 16-gauge steel construction.

b. Nominal 1956 mm by 483 mm by 762 mm 77-inch by 19-inch by 30-inch.

c. Lockable Plexiglas hinged door on front and steel hinged door in rear.

d. Vented roof.

e. Removable side panels.

f. Leveling feet.

2.2.2.5 Cable Management for Equipment Racks

Provide black metal cable management with integral wire retaining fingers. Provide vertical cable management panels that have front and rear channels. Provide vertical cable management panels that have removable front and back covers, made of black metal. Provide a horizontal crossover cable manager at the top of each relay rack, with a minimum height of 2 rack units each. Provide a horizontal crossover cable

manager near the center and at the bottom of each relay rack, with a minimum height of 4 rack units.

2.2.2.6 Patch Panels - Category 6 or better

Provide termination panels that support the appropriate TIA-568-C.1 Category 6 or better (tested to 10 G) applications and facilitate cross-connection and inter-connection using modular patch cords. Size patch panels to fit an EIA standard 483 mm 19-inch rack, or are capable of being mounted to a wall.

Provide patch panels that accommodate at least 48 ports for each rack mount space, and have circuit boards tested in both directions as required by TIA-568-C.1. Provide patch panels that have left angle and right-angle modules to provide optimum cable management, and that have removable six port modules to allow replacement in the field. Provide patch panels that have TIA-568-C.1 Category 6 or better (tested to 10 G) jacks available in both T568A and T568B wiring schemes, with 110-style termination.

Provide patch panels that allow for a minimum of 200 re-terminations without signal degradation below standard compliance limit, and modular ports compliant with FCC Part 68, subpart F and IEC 60603-7 with gold plating over nickel contacts or approved equivalent. Provide patch panels that allow the use of a 4-pair 110-style impact termination tool. Ensure patch panels have a plastic strip for physical protection of the printed circuit board, with port identification numbers on both the front and rear of the panel. Provide clear label holders and white designation labels, with optional color labels available. Provide patch panels that are TIA-568-C.1 Category 6 or better (tested to 10 G) compliant.

Meet the following performance requirements (NEXT Loss and FEXT tested in both Differential and Common Mode):

| PARAMETERS | PERFORMANCE AT 100 MHz |
|---|---|
| NEXT Loss | 43.0 dB |
| FEXT | 35.1 dB |
| Insertion Loss (Attenuation) | 0.4 dB |
| Return Loss | 20 dB |

Provide patch panels that are UL verified for TIA/EIA TIA-568-C.1 Category 6 or better (tested to 10 G) electrical performance, constructed of a steel frame with black powder coat finish, with 48 and 96 port configurations. Provide patch panels that allow the modular insert to accept 110-style patch plugs as a means of termination, and are T-568-B wired. Provide 48 port panels, unless otherwise noted.

Provide paired punch down sequence to allow pair twist within 13 mm 1/2-inch of the termination. Provide port configurations and densities as designated on drawings. Provide rear cable management bar(s) as recommended by the manufacturer, and insulation displacement connector 110-style terminations. Provide TIA-606 compliant color-coded icons or color-coded designation label strips for all patch panels. Identify voice or data functionality as required.

2.2.2.7 Fiber Optic Panels - Wall Mount Box

Provide all panels and trays (units) that cross-connect, and

inter-connect, with splicing capabilities containing cable management for supporting and routing the fiber cables/jumpers. Provide wall mount boxes that are [available in 12, 24 port termination densities for a single door applications,] [available in 12, 24 and 48 port termination densities for dual door applications,] [accommodate various Simplex connectors including ST, SC, FC, dual LC, LX.5, and MT-RJ,] and have single or dual hinged doors. Provide wall mount boxes allowing the mounting of the cable clamp on the interior of the panel, feature adapters which are angled, and have raised outer edges and be putty white in color. Provide wall mount boxes with factory termination of the optical cable as an option. Provide port configurations and densities as called for on drawings.

2.2.2.8 Fiber Optic Panels - Rack Mount (Low Fiber Count)

Provide all panels and trays (units) that cross-connect, and inter-connect, with splicing capabilities containing cable management for supporting and routing the fiber cables/jumpers. Provide rack mount panels with 12 and 24 ports with no splicing, accommodating 24 port configuration for splicing, and allowing for mounting in either 483 mm 19-inch or 584 mm 23-inch equipment bays. Provide rack mount panels that allow [flush] 127 mm 5-inch recess mounting. Use adapter plates that house a minimum of six (6) adapters each, and have adapters angled to the left and right of the panel. Provide only rack mount panels in black or putty, meeting or exceeding all TSB-72 requirements, with port configurations and densities as called for on drawings, wall or rack mountable. Provide rack mount panels with a hinged removable front cover, featuring a front access design with a hinged bulkhead plate.

2.2.2.9 Fiber Optic Panels/Frames - Rack Mount (Moderate Fiber Count)

Provide all panels and trays (units) that cross-connect, and inter-connect, with splicing capabilities containing cable management for supporting and routing the fiber cables/jumpers. Provide rack mount panels in 12, 24, 48, 72, and 96 port configurations, featuring a front access design with hinged bulkhead plate, using adapter plates that house six (6) adapters each. Provide panels with a hinged removable front cover with adapters that are angled to the left of the panel. Provide an integrated vertical cableway on one side of the panel, mountable in flush, 25 mm, 50 mm, and 127 mm 1-inch, 2-inch, and 5-inch recess options, wall mountable. Provide rack mount panels that are 483 mm 19-inch and 584 mm 23-inch rack mountable, with storage and splicing options as part of the product offering, available in black or putty.

2.2.2.10 Fiber Optic Frames - Rack Mount (High Fiber Count)

Provide all panels and trays (units) that cross-connect, and inter-connect, with splicing capabilities containing cable management for supporting and routing the fiber cables/jumpers. Provide rack mount panels in putty or black, made of 12-gauge aluminum alloy. Provide rack mount panels as 24, 32, 48, and 72 port versions with ST or MT-RJ fiber adapters pre-loaded into adapter plates, or 48, 64, 96, and 144 port versions using quad SC fiber adapters pre-loaded into adapter plates. Provide rack mount panels with pre-loaded adapter plates with SC, ST, dual LC, or MT-RJ fiber adapters in 6 and 8 port versions, as well as a 12 port version for the SC adapter. Ensure panels have blank adapter plates for future growth of the fiber infrastructure.

Provide frames with fiber managers to store fiber cable slack and comply with fiber bend radius requirements, with six and eight port fiber adapter

plates, allowing for color coding connectors, and accommodating stackable splice trays. Each tray to have a minimum total of 24 splices. Provide frames with an adapter plate-mounting bracket, which slides out to the front and rear of the unit for increased access. Provide access points for fiber jumpers entering and exiting the unit, and rotating grommets to facilitate cable loading, minimizing micro bending stress, with anchor points for fiber cable(s) entering the unit. Provide labeled frames which meet or exceed TIA-606 requirements and are laser printable.

Provide only frames that are mountable to both 483 mm 19-inch and 584 mm 23-inch rack/cabinets. Provide port configurations and densities as called for on the drawings.

2.2.2.11 Fiber Optic Trays - Rack Mount

Provide all panels and trays (units) that cross-connect, and inter-connect, with splicing capabilities, containing cable management for supporting and routing the fiber cables/jumpers. Provide 18-gauge steel rack mount trays, with a black finish, in 16-, 24-, 28-, 32-, and 48-port configurations, and capable of doubling the port count using 6-port adapters. Provide trays that accommodate SC, ST, dual LC and MT-RJ adapters, hybrid adapter bezels for ST-to-SC or SC-to-ST, or MT-RJ to MT-RJ connections, with changeable ports, which are removable from the front of the unit to allow custom configuration or modification.

Provide rack mount trays with silk screened port identification numbers on both the front and rear of the panel; include slack storage fiber managers to comply with fiber bend radius requirements and slack storage length recommendations. Provide stackable splice trays, managing up to 24 splices per tray, smoked polycarbonate cover and quarter turn screws for easy access. Provide rack mounted trays that do not exceed a 254 mm 10-inch depth for mounting in standard cabinets and enclosures, with strain relief lugs for the fiber cable entering the unit from the side or back, and port configurations and densities as called for on drawings.

2.2.2.12 Backboards

Provide backboards that are 1.2 m by 2.4 m by 19 mm 4 by 8 by 3/4-inch ACX, exterior grade, fire rated plywood, painted with gray, acrylic, interior grade fire-retardant paint. Ensure backboards provide adequate support and dress horizontal cabling between ladder rack and 110 wiring blocks as necessary or as shown on the drawings. Review cable routing plan for the Telecommunications Rooms, in the field, before installation of cabling commences.

2.2.2.13 110 System Blocks

Provide connecting hardware block that supports the appropriate TIA-568-C.1 Category 6 or better applications and facilitate cross-connection and/or inter-connection using either approved cross-connect wire or patch cords. Provide system blocks that are 110 System IDC style blocks, UL verified or equivalent for TIA/EIA Category electrical performance, and TIA-568-C.1 Category 6 or better (tested to 10 G).

Meet the following criteria (NEXT Loss and FEXT tested in both Differential and Common Mode):

| PARAMETERS | PERFORMANCE AT 100 MHz |
|---|---|
| NEXT Loss | 43.0 dB |
| FEXT | 35.1 dB |
| Insertion Loss (Attenuation) | 0.4 dB |
| Return Loss | 20 dB |

Provide system blocks made of flame-retardant thermoplastic, in 50-, 100-, and 300-pair sizes, with 50-, 100-, and 300-pair blocks available without legs, while the 100, and 300 pair blocks are available with legs. Ensure blocks include means to identify cables/services per TIA-606. Provide clear label holders with the appropriate colored inserts available for the wiring blocks. Provide insert labels with the product that contain vertical lines spaces on the basis of circuit size (3-, 4-, or 5-pair) and that do not interfere with running, tracing or removing jumper wire/patch cords. Provide label holders capable of mounting in the under portion of the wiring block. Provide system blocks with connecting blocks used for either the termination of cross-connect (jumper) wire or patch cords. Provide connecting blocks that are available in 3-, 4-, and 5-pair sizes.

Provide all connecting blocks with color-coded tip and ring designation markers, and of single piece construction. Provide system blocks with connecting blocks with a minimum of 200 re-termination without signal degradation below standard compliance limit. Provide blocks that support wire sizes: Solid 0.64 mm to 0.40 mm 22 to 26 AWG, and 7-strand wires. Provide 300 pair blocks made by an ISO 9001 Certified Manufacturer, typical for feed and station cable, unless otherwise noted. Provide keep-off indicator buttons on all active cross-connected pairs used for alarm and security purposes. Coordinate the color and use with the Contracting Officer. Provide connecting block designation label strips of the colors conforming to TIA-606.

2.2.2.14 Cross Connect

Provide modular 110 cross connect blocks for all backbone terminations. Provide cross connects with wire of equal gauge and performance category to that of the feed cable, which it is being connected to. Provide UL listed cross connect, and with one (1) roll of 1-pair and one (1) roll of 2-pair per Telecommunications Room (TR). Coordinate color code of one and two pair with Contracting Officer.

2.2.2.15 Grounding Bars

Provide grounding bar assembly as shown on drawings and a minimum No. 4 grounding electrode conductor from ground bar to suitable electrical building ground. Label grounding and bonding hardware and connections per TIA-606. Provide grounding wire that is appropriately bonded to the grounding bar and electrical building ground rod. Provide ground bar assembly that is constructed with the following materials (see drawing details for additional information):

a. Copper ground bar 16.35 mm by 10.2 cm by 25.4 cm 1/4-inch by 4-inch by 10-inch with 7.15 mm 9/32-inch holes spaced 2.86 cm 1-1/8-inch apart.

b. Stand-off insulators.

c. Lockwashers.

d. Wall mounting brackets.

2.2.2.16 Optical Fiber Patch Cords - Multimode

Provide optical fiber patch cords that are available in standard lengths of 1, 3, and 5 meters, and custom lengths, and meet or exceed standards as defined in TIA-568-C.1. Provide patch cords that use duplex optical fiber cable that is 62.5/125 or 50/125 micron multimode, OFNR riser grade, that uses optical fiber cable where the attenuation does not exceed 3.5 dB/km at 850 nm wave length or 1.0 dB/km at 1300 nm. Equip with SC, ST, dual LC, or MT-RJ connectors. Provide patch cords with terminated connectors exhibiting a maximum insertion loss of 0.75 dB with an average of 0.40 dB when tested at either 850 nm or 1300 nm wave lengths for 62.5/125 um, with terminated connectors exhibiting a maximum insertion loss of 0.75 dB with an average of 0.50 dB when tested at either 850 nm or 1300 nm wave lengths for 50/125 um. Provide optical fiber patch cords that have a minimum return loss of 20 dB (25 dB typical) at both 850 nm and 1300 nm. Provide duplex fiber cable patch cords meeting or exceeding the transmission characteristics of the optical fiber horizontal cable. Provide configuration of patch cords as required to accommodate the application.

2.2.2.17 Category 6 or better (tested to 10 G) Patch Cords

Provide TIA-568-C.1 Category 6 or better (tested to 10 G) patch cords that are round, and consist of eight insulated 24 AWG, stranded copper conductors, arranged in four color-coded twisted-pairs within a flame-retardant jacket, and are equipped with modular 8-position plugs on both ends, wired straight through with standards compliant wiring. Use modular plugs and have gold plating over nickel contacts. Use TIA-568-C.1 Category 6 or better (tested to 10 G) patch cords that are resistant to corrosion from humidity, extreme temperatures, and airborne contaminants, use cable that exhibits power sum NEXT performance, and is available in several colors with or without color strain relief boots providing snagless design.

Provide TIA-568-C.1 Category 6 or better (tested to 10 G) patch cords that meet the flex test requirements of 1000 cycles with boots and 100 cycles without boots, is available in any custom length and standard lengths (3, 5, 7, 10, 15, 20, and 25 feet), and input impedance without averaging 100 ohms plus or minus 15 percent from 1 to 100 MHz. Provide TIA-568-C.1 Category 6 or better (tested to 10 G) patch cords that use cable that is UL verified (or equivalent) for TIA-568-C.1 Category 6 or better (tested to 10 G) electrical performance.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Entrance Facility Terminals

Install frame mounted terminals and field verify actual length required for the input and output stubs. Install clear labeling information at the splice end of the tip cable referencing rack, row, and block. Terminate output stub to appropriate block on distribution frame. Install No. 4 grounding conductor as straight as possible from terminal to ground bar.

### 3.1.2 Surge Protection Modules

Ensure all pairs entering a building are fully protected with active pair surge protection modules or surge protection modules specific to inactive pairs.

### 3.1.3 Floor Mounted Distribution Frames

Install frames as designated on drawings, in accordance with manufacturer instructions. Ensure frames are securely fastened to the floor using expansion anchors, and are plumb and square with the room.

### 3.1.4 Steel Ladder Racking/Cable Tray

Install all ladder rack/cable tray and associated mounting hardware in a manner that allows it to support its maximum rated load. Install ladder rack/cable tray a minimum of 45.7 cm 18-inch above top of floor mounted rack or wall mounted cross-connect fields. Ensure installation complies with manufacturer's instructions.

### 3.1.5 Termination Blocks on Frame

Install color designation strips as follows:

| DESCRIPTION | COLOR |
|---|---|
| C.O. Circuits | Orange |
| Common Equipment - PBX, Lan's, Muxes | Purple |
| First Level Backbone Cable | White |
| Second Level Backbone Cable | Gray |
| Horizontal Wiring | Blue |
| Auxiliary Circuits - Alarm, Security | Yellow |
| Future use and Key Systems | Red |
| Inter-building Campus Backbone | Brown |

Install red insulator clips on all special circuits in the Main Equipment Room termination hardware and cross-connect facilities (ER). Confirm with the Contracting Officer which circuits to designate as special.

### 3.1.6 Floor Mounted Equipment Racks and Cabinets

Ensure all floor mounted equipment racks that anchor to the floor and are plumb. Provide vertical and horizontal cable and terminations as shown on the drawing. Mount with a minimum of 1 m 36-inches clear access behind and in front of rack from the wall to the rack. Install floor mounted equipment racks that ground the rack to the equipment ground bar. Adjacent racks maybe bonded together. Install communication grounding and bonding in accordance with applicable Codes and regulations. Install floor mounted equipment cabinets in a location that allows both the front and rear doors to open a full 90 degrees. Install cabinets employing cooling fans with at least 152 mm 6-inch of clear space above the top of the fan casing.

### 3.1.7 Wall Mounted Equipment Racks and Cabinets

Install wall mounted equipment racks to building structure with approved anchoring means. Verify all existing wall construction and submit proposed

anchoring methods for approval. Install both front and rear vertical and horizontal cable management as required. Install wall mounted equipment cabinets so to not interfere with the use of the front door or hinged body section.

### 3.1.8 Cable Management

Install a horizontal crossover cable manager at the top and bottom of each rack, with a minimum height of 2 rack units each. Install a horizontal crossover cable manager near the center of each relay rack, with a minimum height of 4 rack units. Install two rear cable management bars and reusable Velcro-type hook and loop straps in each rear vertical channel. Provide reusable straps of varying sizes (each allowing 50 percent spare future expansion) and of adequate quantity to secure cable bundles at least every 4 rack units. Secure cable managers, slack managers, support bars, hook and loop straps per manufacturer recommendations.

#### 3.1.8.1 Cable Supports

Install "D" rings 0.6 m 24-inches on center for all exposed, wall mounted vertical Category 6 or better (tested to 10 G) cable runs. Make all horizontal cable runs within room on cable tray.

### 3.1.9 Category 6 or better (tested to 10 G) Patch Panels

Install and label TIA-568-C.1 Category 6 or better (tested to 10 G) patch panels as recommended by manufacturer per TIA-606. Install rear cable management bar(s) as recommended by manufacturer. Attach compliant color-coded icons or color-coded designation label strips for all patch panels per TIA-606. Identify voice or data functionality.

Install panels to provide minimal signal impairment by preserving wire pair twists as closely as possible to the point of mechanical termination. Ensure the amount of untwisting in a pair as a result of termination to the patch panel is not greater than 13 mm 0.5-inches.

Install panels according to manufacturer's instructions and properly mounted to a rack, cabinet, bracket, or other appropriate mounting device.

Install panels such that cables terminated to the panel maintain a minimum bend radius of at least 4 times the cable diameter into the IDC contacts. Terminate cables on the panels to ensure there is no tension on the conductors in the termination contacts.

Properly label panels on front and back with the cable number and port connections for each port.

### 3.1.10 Optical Fiber Patch Panels

Install panels according to manufacturer's instructions. Furnish and install labels for each strand, and install blank adapter panels in all positions not used at time of installation for fiber terminations.

Install adhesive or snap-in routing clips that are secured to the inside of the adapter tray that allow and maintain the minimum bend radius of the cable and the proper storage of at least 2 m 6-1/2-foot of fiber cable inside the tray.

Properly anchor incoming cable as it enters the rear or bottom of the

tray. Install the anchor to the cable jacket without the use of excessive force and without crushing the cable jacket.

### 3.1.11 Backboards

Per the drawings, line the linear wall space used for anchoring equipment for the full room width with plywood. Install plywood for mounting termination equipment vertically, side by side and a minimum of 152 mm 6-inches above finished floor. Install plywood for supporting backbone riser cables vertically and resting directly on the finished floor.

Ensure anchoring and mounting techniques of plywood used to support backbone riser cables are sufficient to support a minimum of 453 kg 1000 pounds of weight. Ensure heads of mounting screws do not protrude past the face of any plywood. Install distribution rings, two rings per vertical row of blocks, for the cross-connect fields above all wall mounted blocks. Mount rings with two hex head screws per ring.

### 3.1.12 110 System Blocks

Install 110 system blocks on plywood backboard so that top of 300 pair block is 1.7 m 66-inches above finished floor, or as noted on the drawing. Install blocks using steel, zinc plated 8 mm 5/16-inch slotted hex head No. 10 by 19 mm3/4-inch drill screws, minimum four screws per block. Install designation strips color-coded in conformance with TIA-606 standard, as follows:

| DESCRIPTION | COLOR |
|---|---|
| C.O. Circuits | Orange |
| Common Equipment - PBX, LAN, Mux | Purple |
| First Level Backbone Cable | White |
| Second Level Backbone Cable | Gray |
| Horizontal Wiring | Blue |
| Auxiliary Circuits - Alarms, Security | Yellow |
| Future Use and Key Systems | Red |
| Inter-building Campus Backbone | Brown |

### 3.1.13 Grounding and Bonding

Install a copper ground bar in each communication equipment room, as per the plans, and bond all metallic equipment racks, conduits, cable trays, ladder racks, etc. to the ground bar, using 13.0 mm2 No. 6 AWG (minimum) equipment grounding conductor. Ensure all connectors and clamps are mechanical type made of silicon bronze, and terminals are solderless compression type, copper long-barrel NEMA two bolt. Bond the shield of shielded cable to the ground bar in communications rooms and spaces, per applicable code and manufacturer's recommended practices. Install communication grounding and bonding that is in accordance with applicable codes and regulations.

### 3.1.14 Miscellaneous Requirements

Neatly dress, rack, label, and terminate all cables in communication rooms. Ensure a minimum of 609 mm 24-inch service loop on each terminated conductor, unless otherwise specified.

Ensure room support services include HVAC, lighting, power, and fire

protection as designated on the drawings.

Firestop all sleeves and conduit openings after the cable installation is complete.

## 3.2 CLOSEOUT ACTIVITIES

### 3.2.1 Record Drawings

Submit final record "As-built" drawings at the completion of the project of the following:

a. Scaled 1:50 1/4-inch by 1-foot Communication Room floor plans showing all installed components.

b. Front elevations of all systems patch panels.

-- End of Section --