097.130 AWH
07-21-2017

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
OFFICE OF THE SECRETARY
MANILA

18 JUL 2017

DEPARTMENT ORDER) **SUBJECT : DPWH Standard Specification on Item 1104 – Auxiliary System**
No. 87)
Series of 2017) 07.14.17

In order to provide specifications for grounding systems which are specified in the Department Order No. 05, Series of 2017 (*Revised Standardized Pay Items of Works for Civil Works Construction for Infrastructure Projects)*, and also, in line with the mandate of the Department in providing effective Standard Specifications in the implementation of various infrastructure projects, the attached **DPWH Standard Specification on Item 1104 – Auxiliary System** is hereby prescribed, for the guidance and compliance of all concerned.

This specification shall form part of the on-going revision of the DPWH Standard Specifications for Public Works Structures - Buildings, Ports and Harbors, Flood Control and Drainage Structure and Water Supply Systems, Volume III, 1995 Edition.

This Order shall take effect immediately.

MARK A. VILLAR
Secretary

14.1.2 FET/RGT

Department of Public Works and Highways
Office of the Secretary
WIN7U01493

DPWH Standard Specification of
Item 1104 – AUXILIARY SYSTEM

1104.1 Description

This Item shall consist of furnishing and installation of all materials, components, and equipment to complete the requirements for Auxiliary System in accordance with the Plans and Specifications.

1104.2 Definition

Backbone. A facility (e.g. pathway, cable or conductors) between telecommunications rooms, or floor distribution terminals, the entrance facilities, and the equipment rooms within or between buildings.

Bundled Cable. An assembly of two or more cables continuously bound together to form a single unit.

Cable. An assembly of one or more insulated conductors or optical fibers, within an enveloping sheath.

Cross-connect. A facility enabling the termination of cable elements and their interconnection or cross-connection.

Coaxial Cable. A telecommunications cable of consisting of round center conductor surrounded by a dielectric surrounded by a concentric cylindrical conductor (shield) and an optional insulating sheath.

Connector (Jack). A female telecommunications connector that may be keyed or unkeyed and may have six or eight connector that may be positions, but not all the positions need to be equipped with jack contacts. Jacks are typically used to terminate cable at the user end and are inserted into faceplates to create connection point for the user's equipment cord.

Electromagnetic Interference (EMI). Radiated or conducted electromagnetic energy that has an undesirable effect on electronic equipment or signal transmissions.

Enclosure. The case or housing of apparatus, or the fence or walls surrounding an installation to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage.

Entrance Facility (telecommunications). An entrance to building for both public and private network service cables (including wireless) including the entrance point of the building and continuing to the entrance room or space.

Equipment Room (ER). An environmentally controlled centralized space for telecommunications that houses main or intermediate cross-connect. An ER can contain equipment to support all of the following: entrance protection, cable infrastructure pathway, data and voice services, PBX, demarcation point, wireless, paging, fire/smoke detection, security alarm systems, radio, area of rescue assistance equipment, CATV and video conferencing.

Firestop. A fire-rated material, device, or assembly of parts installed in a penetration of firerated barrier.

Firestopping. The process of installing listed, fire-rated materials into penetrations in fire-rated barriers to reestablish the fire-resistance rating of the barrier.

Horizontal Cabling. 1) The cabling between and including the telecommunications outlet/connector and the horizontal cross-connect. 2) The cabling between and including the building automation system outlet or the first mechanical termination of the horizontal connection point at the horizontal cross-connect.

Jumper. An assembly of twisted pairs without connectors, used to join telecommunications circuits/links at the cross - connect.

Listed. Equipment included in a list published by an organization, acceptable to the authoriry having jurisdiction that maintains periodic inspection of production of listed equipment, and whose listing states either that the equipment or material meets appropriate standards or has been tested and found satiable for use in a specified manner.

Optical fiber. Any filament made of dielectric materials that guides light.

Optical fiber cable. An assembly consisting of one or more optical fibers.

Outside plant. Telecommunications infrastructure designed for installation exterior to buildings.

Patch cord. A length of cable with a plug on one or both ends.

Patch panel. A connecting hardware system that facilitates cable termination and cabling administration using patch cords.

Pathway. A facility for the placement of telecommunications cable.

Permanent Link. A test configuration for a link excluding test cords and patch cords.

Plenum. A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.

Pull Point. A pull point is a space use to transition between floors for backbone and horizontal cabling within a building system.

Sleeve. An opening, usually circular, through the wall, ceiling, or floor to allow the passage of cables.

Telecommunications Room (TR). A TR is a special purpose room designed to a single floor. In buildings with multiple floors, TR's shall be vertically stacked to form a backbone pathway. The TR is the point in the voice and data infrastructure that the backbone and horizontal distribution systems are connected to each other. A TR can contain equipment to support all of the following: cable infrastructure, data and voice communications, wireless (satellite), paging, fire/smoke detection, security alarm systems, radio, area of rescue assistance equipment, CATV and video conferencing.

Standard References Acronyms:

ANSI. American National Standards Institute

EIA. Electronic Industries Alliance

ICEA. Insulated Cable Engineers Association

ITE. Information Technology Equipment

NEC. National Electrical Code

PEC. Philippine Electrical Code

TIA. Telecommunication Industry Association

1104.3 General

The Contractor, approved manufacturer and Site Engineer are held responsible to be familiar with the provisions contained herein and is assumed to possess the knowledge, manpower, and materials applicable to the completion of the installation.

1104.4 Material Requirements

All materials and equipment shall be brand new and shall conform to the Philippine Electrical Code, Philippine Electronics Code, the National Electrical code and other acceptable references and shall be approved by the Engineer.

1104.4.1 Unshielded Twisted Pair (UTP)

Unshielded Twisted Pair (UTP) is the most popular and is generally the best option for school networks. UTP quality may vary from extremely high-speed cable to telephone-grade wire. Four (4) pairs of cable wires exist inside the jacket.

1104.4.1.1 Categories of Unshielded Twisted Pair:

1. **Category 1:** Alarm systems, voice only (telephone wire), characteristics specified up to 0 (MHz) and other noncritical applications.

2. **Category 2:** Voice, EIA-232, data to 4 Mbps (Local Talk), characteristics specified up to 0 (MHz) and the lower speed data.

3. **Category 3:** 10Base Ethernet, 4-Mbit/s token ring, 100BaseT4, 100VG-AnyLAN, basic rate ISDN, data to 10 Mbps (Ethernet) and characteristics specified up to 16 (MHz). Generally the minimum standard for new installations.

4. **Category 4:** 16-Mbit/s token ring. Not widely used, data to 20 Mbps (16 Mbps token ring) and characteristics specified up to 20 (MHz).

5. **Category 5:** TP-PMD, SONet, OC-3 (ATM), 100BaseTX. The most popular for new data installations, data to 100 Mbps (Fast Ethernet) and characteristics specified up to 100 (MHz).

1104.4.1.2 Unshielded Twisted Pair Connector

An RJ-45 connector is the standard connector for an unshielded twisted pair cabling. This is a plastic connector that looks like a large telephone-style connector. The placement of a slot allows the RJ-45 to be inserted only one (1) way.

1104.4.2 Coaxial Cable

Coaxial Cabling has a single copper conductor at its center. A plastic layer provides insulation between the center conductor and a braided metal shield. The metal shield helps to block any outside interference from fluorescents lights, motors and other computers.

1104.4.2.1 Two (2) Types of Coaxial Cable

1. **Thin Coaxial.** Thin coaxial cable is also referred to as thinnet. 10base2 refers to the specifications for thin coaxial cable carrying Ethernet signals. The two (2) refers to the approximate maximum segment length being 000 meters. Thin coaxial cable is popular in school networks, especially linear bus networks.

2. **Thick coaxial.** Thick coaxial cable is also referred to as thicknet. 10Base5 refers to the specifications for thick coaxial cable carrying Ethernet signals. The five (5) refers to the maximum segment length being 500 meters. Thick coaxial cable has an extra protective plastic cover that helps keep moisture away from the center conductor.

1104.4.3 Optical Fiber Cable

Optical Fiber Cable shall consist of 50/125 mm or 62.5/125 mm multicode optical fibers or single mode optical fibers, or a combination of these media. Individual fibers and group of fibers shall be identifiable in accordance with the requirements pf EIA/TIA. The cable shall be listed and marked as required under the applicable electrical code and local building code requirements.

1104.4.3.1 Physical Cable Specification:

1. Inside Plant Cable

The mechanical and environmental specifications for inside plant optical fiber cable shall be in accordance with *ANSI/ICEA S-83-596, Fiber Optic Premises Distribution Cable.*

Two (2) and four (4) – fiber cables intended for horizontal or centralized cabling shall support a bend radius of 25 mm under no-load conditions. 2-and 4-fiber cables intended to be pulled through horizontal pathways during installation shall support a bend radius of 50 mmm under a pull load of 222 N. All other inside plant cables shall support a bend radius of ten (10) times the cable outside diameter when not subject to tensile load, and 15 times the cable outside diameter when subject to tensile loading up to the cable's rated limit.

2. Outside Plant Cable

The mechanical and environmental specifications for outside plant optical fiber cable shall be in accordance *with ANSI/ICEA S-87-640, Fiber Optic Outside Plant Communication Cable.*

Outside plant optical fiber cables shall be of a water-block construction and meet the requirements for compound flow and water penetration as established by *ANSI/ICEA S-87-640, Fiber Optic Outside Plant Communication Cable.* Outdoor cable shall have a minimum pull strength of 2670 N. Outside plant cables shall support a bend radius of ten (10) times the cable outside diameter when not subject to tensile load, and 20 times the cable outside diameter when subject to tensile loading up to the cable's rated limit.

1104.4.4 Balance Twisted – Pair Cables

1104.4.4.1 Recognized Categories

The recognized categories of twisted-pair cabling are:

1. Cat5e Cable

This designation applies to 100 Ω cables whose transmission characteristics are specified up to 100 MHz.

2. Cat6 Cable

This designation applies to 100 Ω cables whose transmission characteristics are specified up to 16 MHz.

1104.4.4.2 Horizontal Cable

The cable shall consist of 22 AWG to 24 AWG thermoplastic insulated solid conductors that are formed into four (4) individually twisted-pairs and enclosed by a thermoplastic jacket.

1104.4.4.2.1 Physical Design of Horizontal Cables:

1. Insulated Conductor

The diameter of the insulated conductor shall be 1.22 mm maximum.

2. Pair Assembly

The cable shall be restricted to four (4) twisted-pair conductors. The pair twist lengths shall be chosen to ensure compliance with the transmission requirements of this Standard.

3. Color Codes

Color Code for the horizontal shall be as follows:

Table 1 – Color Code for 4-pair Horizontal Cable

Conductor Identification	Color Code	Abbreviation
Pair 1	White-Blue	(W-BL)
	Blue	(BL)
Pair 2	White-Orange	(W-O)
	Orange	(O)
Pair 3	White-Green	(W-G)
	Green	(G)
Pair 4	White-Brown	(W-BR)
	Brown	(BR)

The wire insulation is white and a colored marking is added for identification. For cables with tightly twisted-pairs (all pairs less than 38 mm per twist) the mate conductor may serve as the marking for the white conductor. A white marking is optional.

4. Cable Diameter

The diameter of the completed cable shall be less than 6.35 mm.

5. Breaking Strength

The ultimate breaking strength of the cable, measured in accordance with *ASTM D 4565, "Standard Test Methods for Physical and Environmental Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable,* shall be 400 N minimum.

6. Bending Radius

Twisted-pair cables shall withstand a bend radius of 25.4 mm at a temperature of 20 °C ± 1 °C, without jacket or insulation cracking, when tested in accordance with *ASTM D 4565, "Standard Test Methods for Physical and Environmental Performance Properties of Insulations and Jackets for Telecommunications Wire and Cable".* For certain applications (e.g. pre-cabling buildings in cold climate), the use of cables with a lower temperature bending performance of -30 °C ± 1 °C shall be considered.

1104.4.4.2.2 Other Design Requirements of Horizontal Cable:

1. The proximity of horizontal cabling to sources of electromagnetic interference (EMI) shall be taken into account.

2. One transition point (TP) shall be allowed between different forms of the same cable type (where undercarpet cable connects to round cable).

3. A minimum of two (2) telecommunications outlets shall be required for each individual work area. The first outlet: 100 ohm UTP; and, the second outlet: 100 ohm UTP, 150 Ohm STP-A or 62.5/125 µm multimode fiber.

4. Grounding shall conform to applicable building codes, as well as *ANSI/TIA-607, "Commercial Building Grounding and Bonding Requirements for Telecommunication System".*

5. Additional outlets may be provided. These outlets are in addition to and may not replace the minimum requirements of the standard.

6. Bridged taps and splices shall not be allowed for copper-based horizontal cabling. Splices shall be allowed for fiber.

7. Multi-unit cable shall be allowed, provided that they meet hybrid crosstalk requirements.

8. The horizontal cabling shall be configured in a star apology; each work outlet is connected to a horizontal cross-connect (HC) in a telecommunication closet (TC).

9. In addition to the 90 meters of horizontal cable, a total of 10 meters shall be allowed for work area and telecommunications closet patch and jumper cables. Each work area shall have a minimum of two (2) information outlet ports, one (1) for voice and one (1) for data.

1104.4.4.3 Backbone Cable

Multipair backbone cables consist of 22 AWG to 24 AWG thermoplastic insulated solid conductors that are formed into one or more units of balanced twisted pairs. The units are assembled into binder groups of 25 pairs or part thereof following the standard industry color code of *ANSI/ICEA S-80-576, "Category 1 & 2 Individually Unshielded Twisted Pair Indoor Cables for Use in Communications Wiring Systems".*

The groups are identified by distinctly colored binders and assembled to form the core. The core shall be covered by a protective sheath. The sheath consists of an overall thermoplastic jacket and may contain an underlying metallic shield and one or more layers of dielectric material applied over the core.

1104.4.4.3.1 Physical Design of Backbone Cables:

1. Insulated Conductor

The diameter of the insulation conductor shall be 1.22 mm maximum.

2. Pair Assembly

The pair twist lengths shall be specified to ensure compliance with the transmission requirements of the *EIA/TIA-568 B.2, "Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted – Pair Cabling Components".*

3. Color Code

For backbone cables with more than 25 pairs, the core shall be assembled in units or sub-units of up to 25 pairs. Each unit or sub-unit shall be identified by a color-code binder. Color coding shall be in accordance with *ANSI/ICEA S-80-576, "Category 1 & 2 Individually*

Unshielded Twisted Pair Indoor Cables for Use in Communications Wiring Systems". Binder color-code integrity shall be maintained whenever cables are specified.

4. Core Wrap

The core wrap may be covered with one or more layers of dielectric material of adequate thickness to ensure compliance with the dielectric strength requirements.

5. Core Shield

When an electrically continuous shield is applied over the core wrap, it shall comply with requirements of *EIA/TIA-568-B.2, "Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted – Pair Cabling Components".*

6. Jacket

The core shall be enclosed by a uniform, continuous thermoplastic jacket.

1104.4.4.3.2 Other Design Requirements of Backbone Cables

1. Equipment connections to backbone cabling shall be made with cable lengths of 30 m or less.

2. The backbone cabling shall be configured on a star topology. Each horizontal cross-connect is connected directly to a main cross-connect or to an intermediate cross-connect, then to main cross-connect.

3. The backbone shall be limited to no more than two (2) hierarchical levels of cross-connects (main and intermediate). No more than one (1) cross-connect may exist between a main and a horizontal cross-connect and no more than three-cross-connect may exist between any two (2) horizontal cross-connects.

4. Cross-connects for different cable types shall be located in the same facilities.

5. A total maximum backbone distance of 90 m is specified for certain applications. This distance is for uninterrupted backbone runs. (No intermediated cross-connect).

6. The proximity of backbone cabling to sources of electromagnetic interferences (EMI) shall be taken into account.

7. The distance between the termination in the entrance facility and the main cross-connect shall be documented and shall be made available to the service provider.

8. Recognized media may be used individually or in combination, as required by the installation. Quantity of pairs and fibers needed in individual backbone runs depends on the area served.

9. Multipair cable shall be allowed, provided that it satisfies the power sum crosstalk requirements.

10. Bridge taps shall not be allowed.

11. Main and intermediated cross-connect jumper or patch cord lengths shall not exceed 20 m.

12. Avoid installing in areas where sources of high levels of EMI/RFI (Electromagnetic Interference/Radio Frequency Investigation) may exist.

13. Grounding shall meet the requirements as define din the EIA/TIA 607, "Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises".

1104.4.5 Building Entrance

1104.4.5.1 Service Entrance Pathways

1. A minimum of 101.6 mm conduit or duct made of PVC type B, C or D, multiple plastic duct, galvanized steel fiber glass shall be used for underground facilities approved by the Engineer.

2. Appropriate encasement shall be provided.

3. No more than two (2) 90 degree manufactured bends shall be allowed (10 times the diameter).

4. Drain slope shall not be less than 304.8 mm per 30.48 m.

5. Recommended conduit fill varies but shall not exceed 40% for more than two (2) cables.

6. Maintenance holes (typically 24 Mpa concrete) shall be equipped with sump, corrosion-protection pulling iron, cable racks, grounded ladder and only such power and light conductors as required for telecommunications supports per National Electrical Code requirements.

1104.4.5.2 Entrance Facilities

1. Entrance facilities shall include the pathways for outside carrier services, interbuilding backbone alternate entrance and antenna entrance pathways. The entrance facilities shall consist of a termination field interfacing any outside cabling to the intrabuilding backbone cabling.

2. The local telephone carrier shall be required to terminate cabling within 15.24 meters of building penetration and to provide primary voltage protection.

3. In buildings larger than 1,858.06 usable sq. meter, a locked, dedicated, enclosed room is recommended. Beyond, 6,503.21 sq.m., a locked, dedicated room is required, with a plywood termination field provided on two (2) walls. In buildings up to 9,290.30 usable sq. m., a wall-mounted termination field may serve as the entrance facility, using a ¾ inch plywood, 2.44 m high. Beyond 9,230.30 sq.m, rack-mounted and free-standing frames may also be required. The following table is a guideline to determine the minimum space requirement for entrance facility:

Table 2 - Minimum Space Requirements

Gross Building Floor Space (Sq.m)	Plywood Field Room Dimension	Field Room Dimension
464.52	2.44 m high x 11.89 m wide	(A room recommended beyond this level)
929.03	2.44 m high x 11.89 m	
1,858.06	2.44 m high x 12.80 m	
3,716.12	2.44 m high x 20.73 m	
4,645.15	2.44 m high x 27.43 m	
5,574.18	2.44 m high x 29.26 m	(A dedicated room required)
7,432.24	2.44 m high x 36.58 m	3.66 m x 1.92 m
9,290.30	2.44 m high x 2 walls	3.66 m x 1.92 m
18,580.61	2.44 m high x 2 walls	3.66 m x 2.74 m
37,161.22	2.44 m high x 2 walls	3.66 m x 3.96 m
46,451.52	2.44 m high x 2 walls	3.66 m x 4.75 m
55,741.82	2.44 m high x 2 walls	3.66 m x 5.58 m

Rule of Thumb: *Allow 0.093 sq.m of plywood wall mount for each 18.58 sq.m. area of floor space.*

1104.4.6 Equipment Room

An equipment room is essentially a large telecommunications room that may house the main distribution frame, PBXs, secondary voltage protection, etc. The equipment room is often appended to the entrance facilities or a computer room to allow shared air conditioning. Security, fire control, lighting and limited access.

Number of Workstation	Equipment Room Floor Space (sq. m)
1 -100	13.94
101 – 400	37.16
401 – 800	74.32
801 – 1,200	111.48

Rule of Thumb: *Provide 0.070 sq.m. of equipment room floor space for every 9.29 sq.m of user workstation area.*

1. Location

Typically, rooms shall be located away from sources of electromagnetic interference (transformers, motors, x-ray, induction heaters, arc welders, radio and radar) unless interference is less than 3 V/m across the frequency spectrum. Avoid sources of flooding.

2. Perimeters

Typically, no false ceiling. All surfaces shall be treated to reduce dust. Walls and ceiling shall be painted white or pastel to improve visibility.

3. Door

The door shall be a minimum of 0.9 m wide and 2 m high, with no doorsill, hinged to open outward (code permitting), slide side-to-side, or be removable. The door shall be fitted with a lock. If it is anticipated that large equipment will be delivered to the entrance room, a

double door, 1.8 mm wide by 2.3 m high, with no doorsill or center post, is recommended. If the door must open inwards, the size of the room (floor space) shall be increased accordingly.

4. Exterior Windows

The telecommunications space shall not have exterior windows, as exterior windows may increase heat load.

5. Other

Typically, no piping, ductwork, mechanical equipment or power cabling shall be allowed to pass through the equipment room. No unrelated storage.

6. Heat, Ventilation and Air Conditioning (HVAC)

HVAC shall be provided on 24 hours a day, 365 days a year, 17.78 °C to 23.89 °C, 30 to 55% humidity, and positive pressure.

7. Lighting

Lighting shall be a minimum of 500 lux in the horizontal plane and 200 lux in the vertical plane, measured one (1) m above the finished floor in the middle of all aisles between cabinets and racks.

Lighting fixtures shall not be powered from the same electrical distribution panel.

Dimmer switches shall not be used.

8. Electrical

Typically, a minimum of two (2) dedicated 20/25 A, 220/230 VAC duplex outlets on separate circuits is required. Convenient duplex outlets shall be placed at 1.83 m intervals around the perimeter. Emergency power shall be considered and supplied if available.

9. Contaminants

Telecommunications building spaces shall be protected from contaminants and pollutants that could affect operation and material integrity of the installed equipment. The level of contaminants can be reduced using barriers, positive room pressure, and absolute filters or other means.

1104.4.7 Telecommunications Rooms

The telecommunications room on each floor is the junction between backbone and horizontal pathways. It contains active voice and data telecommunications equipment, termination fields and cross-connect wiring. More than one (1) telecom room per floor shall be required if distance to a work area exceeds 91.44 meters, of if floor area served excess 929.03 sq. meter. Recommended room sizing is 3.05 m x 3.35 m for each 929.03 sq. m area served.

There are a minimum of three (3) 101.6 mm firestopped backboned sleeves in the floor at the left side if a plywood termination field, which are ideally located near the door. A fire extinguisher is recommended.

1. Door

The door shall be a minimum of 0.9 m wide and 2 m high, with no doorsill, hinged to open outward (code permitting), slide side-to-side, or be removable. The door shall be fitted with a lock. If it is anticipated that large equipment will be delivered to the entrance room, a double door, 1.8 mm wide by 2.3 m high, with no doorsill or center post, is recommended. If the door must open inwards, the size of the room (floor space) shall be increased accordingly.

2. Exterior Windows

The telecommunications space shall not have exterior windows, as exterior windows may increase heat load.

3. Heat, Ventilation and Air Conditioning (HVAC)

HVAC shall be provided on 24 hours a day, 365 days a year, 17.78 °C to 23.89 °C, 30 to 55% humidity, and positive pressure.

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Lighting shall be a minimum of 500 lux in the horizontal plane and 200 lux in the vertical plane, measured one (1) m above the finished floor in the middle of all aisles between cabinets and racks.

Lighting fixtures shall not be powered from the same electrical distribution panel.

Dimmer switches shall not be used.

5. Electrical

Typically, a minimum of two (2) dedicated 20/25 A, 220/230 VAC duplex outlets on separate circuits is required. Convenient duplex outlets shall be placed at 1.83 m intervals around the perimeter. Emergency power shall be considered and supplied if available.

6. Contaminants

Telecommunications building spaces shall be protected from contaminants and pollutants that could affect operation and material integrity of the installed equipment. The level of contaminants can be reduced using barriers, positive room pressure, and absolute filters or other means.

1104.4.8 Telecommunication Closet

A telecommunication closet is the area within a building that houses the telecommunications cabling system equipment. This includes the mechanical terminations and/or cross-connect for the horizontal and backbone cabling system.

1104.4.8.1 Telecommunication Closet Design Requirements

1. Closets shall be designed and equipped in accordance with *ANSI/EIA/TIA 569-A, "Commercial Building Standard for Telecommunication Pathways and Spaces".*

2. Cable stress from tight bends, cable ties, and tension shall be avoided by well-designed cable management.

3. Cables and cords used for active equipment connections are outside the scope of the standard (10 m total allowed for patch cords and equipment cables on both ends of each link).

4. Only standards-compliant connecting hardware shall be used.

5. Equipment connections at a cross-connect may be made by way of interconnections or cross-connections between cabling subsystems and for connections to equipment with multiport connectors. Interconnections are used for connections to equipment with single-port connectors.

1104.4.9 Pathways

1104.4.9.1 Intra-building Backbone Pathways

1. Within a building, the intra-building backbone pathways extend between the entrance facilities, equipment room and telecommunication rooms.

2. Telecom rooms shall be stacked vertically above each other on each floor, and provided with a minimum of three (3) 4-inch sleeves (a stub of conduit through the floor) for less than 4,645.15 sq. m served.

3. An equivalent 101.6 m x 304.8 m slot may be used in lieu of three (3) sleeves. Firestopping is required.

4. If rooms are not vertically aligned, then 101.6 m horizontal conduit shall be required.

5. Include no more than two (2) 90 degree bends between pull points. Pulling iron or eyes embedded in the concrete for cable pulling is recommended. Fill shall not exceed 40% for any run greater than two (2) cables.

1104.4.9.2 Horizontal Pathways

Horizontal pathways extend between the telecommunications room and the work area. Horizontal pathways should be earthed in accordance with local electrical codes and in accordance with AS/CIF S009. A variety of generic pathway options are described. Choice of pathway(s) is left to the discretion of the Professional Electronics Engineers. The most commonly employed pathway consists of cable bundles from the telecom room along the J-hooks suspended above a plenum ceiling, which fan out once a work zone is reached. They then dropped through interior walls or support columns or raceways, and terminate at an information outlet (I/O). Other options include the following:

1. Underfloor Duct

Single or dual-level rectangular ducts embedded in greater than 63.5 mm concrete flooring.

2. Flushduct

Single-level rectangular duct embedded flush in greater than 25.4 mm concrete flooring.

3. Multi-channel Raceway

Cellular raceway ducts capable of routing telecom and power cabling separately in greater than 76.2 m reinforced concrete.

4. Cellular floor

Pre-formed hollow or steel-lined cells are provided in concrete with header cuts from the telecom room arrange at right angles to the cells.

5. Trenchduct

A wide, solid tray, sometimes containing compartments, and fitted with as flat top (with gaskets) along its entire length, It is embedded flush with the concrete finish.

6. Access Floor

Modular floor panels supported by pedestals, used in computer rooms and equipment rooms.

7. Plenum/Ceiling

Bundled cables, suspended above a false ceiling, fan out to drop through walls, power poles or along support columns to baseboard level.

8. Conduit

To be considered only when outlet locations are permanent, device density low and flexibility (future changes) are not required.

9. Cable Trays

Options include channel tray, ladder tray, solid bottom, ventilated and wireway.

10. Perimeter Pathways

Options include surface raceway, recessed, molding and multichannel (to carry separate power and lighting circuits).

Rule of Thumb: Typically, size of horizontal pathways by providing 645.16 mm of cross-section area for every 9.29 sq.m of workspace area of being served.

1104.4.10 Modular Connectors (Jacks/Outlets)

1. Furnish and install modular connectors consisting of RJ45 8-position modular jacks, meeting or exceeding transmission performance of Category 6a.

2. Modular connectors shall be mounted in modular cover plates.

3. Modular connectors shall be UL Listed and comply with EIA/TIA.

4. All modular jacks shall be blue in color when utilized for "data" and red in color when utilized for "voice", unless otherwise directed by the Contractor. Confirm all colors with Networking and Telecommunications prior to ordering materials.

5. Furnish and install keystone style jacks as may be required to be compatible with special assemblies such as poke-thru assemblies.

6. Apply blank inserts to all unused openings. Blank inserts shall be International White in color.

1104.4.11 Cable Management and Ladder Rack

1. All materials and equipment to be furnished shall be brand new and standard products of a single manufacturer regularly engaged in the production of such equipment.

2. Ladder rack shall be constructed of rectangular steel tubing.

3. Junction for ladder rack shall be constructed of solid tubular steel.

4. Cable straps shall be manufactured for the specific use of bundling cable.

1104.4.12 Cabinets, Racks and Enclosures

1104.4.12.1 Equipment Rack

1. Equipment rack shall be either freestanding or wall mounting equipment cabinet/enclosures and sized as required in the drawings.

2. Minimum rack width shall be 480 mm.

3. Can accommodate a load of 90.72 kgs per shelving provision and support a total load of at least 544.31 kgs.

4. Equipment rack shall be equipped with the following:

    4.1 Hinged doors with reversible swing and lock for protection.

    4.2 Grounding busbar kit inside equipment rack.

    4.3 Power strip with surge protection and have a minimum of 6-receptacle outlets on the power strip (if any).

4.4 Vertical wire management extending the full height of the rack including both sides: front and back.

4.5 Contain knockouts for cable accessed along the top, bottom, or rear panels.

4.6 Freestanding cabinets shall be accessible from both front and back.

4.7 Provision for additional rack mounted fans and exhaust vents or if possible air ducts.

1104.4.12.2 Enclosure/Cabinet

1. Equipment cabinet shall be either freestanding or wall mounting equipment/enclosures and sized as required in the drawings.

2. Equipment cabinet shall be modular steel unit and with Gauge#16 or better, grade steel.

3. Each cabinet shall have a backboard for device mounting. Backboard shall be fire retardant treated plywood and 20 mm thick.

4. Unless otherwise indicated, cabinet shall have a hinged cover with locking device.

1104.4.13 Patch Panel

The patch panel shall include the following features:

1. Category 6 Patch panel shall be 1U high and support 24 modular jack ports or 2U high and support 48 modular jack ports and shall accept RJ-45, 8-Position modular plugs.

2. Patch Panels shall terminate the building cabling on an IDC (Insulation Displacement Connector) type connector or module.

3. Category 6 UTP modular jack insulation displacement contacts shall be capable of terminating solid conductors from diameter 0.05 mm to 0.065 mm (24 to 22 AWG).

4. The installed system shall comply with the Category 6 performance characteristics as required by TIA and ISO Standards.

1104.4.14 Patch Chords

Patch cords shall be provided when patching of voice and/or data circuits is required at the cross-connections. The patch cords supplied shall able to support the designed specifications.

The patch cord shall include the following features:

1. RJ 45 Cat 6 patch cords shall be installed for the user work area.

2. Patch cords shall be factory terminated with 4-pair UTP stranded cable.

1104.4.15 Faceplate

1. Furnish and install a single gang modular cover plate with one (1), two (2), three (3), and four (4) modular outlet openings for "Voice"and "Data" as indicated on the Plans.
2. Modular cover plates shall be plastic or stainless steel as required to match electrical plates unless otherwise specified by the Contractor. Plastic modular furniture cover plates shall match the furniture's kick plate color when possible.
3. Furnish and install 106-style modular mounting frames where required to adapt to surface raceway as may be provided by this Specification.
4. A clear label shall be provided for application

1104.5 Construction Requirements

1104.5.1 General

Installation of Auxiliary System shall be in accordance with the governing laws and approved codes and standards.

1104.5.2 Submittals

The following shall be submitted by the Contractor:

1. **Product Submittal.** Submit physical sample, manufacturer's data sheets, listings, certificates and approvals for all proposed equipment and materials. Where a page shows more than one (1) type of product, identify the intended item to be used for the project.

2. **Shop Drawings**

   2.1 Submit fabrication and installation details of components.
   2.2 Drawings on plan layout showing principal routings.
   2.3 Methodology of support hanger installation.

3. **Test Reports.** Indicate satisfactory completion of required tests and inspections. Test reports shall be provided prior to the acceptance of the project. Summary of test reports and individual test results shall be part of the close-out submittals and as-built plans.

4. **Manufacturer's Installation Instructions.** Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of the products.

5. **Product Record Documents.** Record actual locations of initiating devices, signaling appliances, and end-of-line devices.

6. **Operation and Maintenance Data**

   6.1 Operation Data. Operating instructions.
   6.2 Maintenance Data. Maintenance and repair procedures.

1104.5.3 Labeling

Each piece patch panel and outgoing cable from the patch panels shall be labeled. Corresponding labeling and numbering shall also be provided on the telecom outlets.

1. Cables. Horizontal and backbone cables shall be labeled at each end.

2. Faceplates. A unique identifier shall be marked on each faceplate.

3. Rack, Panels and Wiring Modules. A unique identifier shall be marked on the connecting hardware.

1104.5.4 Firestopping

All firestop systems shall be installed in accordance with the manufacturer's recommendations and shall be completely installed and available for inspection by the local inspection authorities prior to cabling system acceptance.

1. Apply fire-rated materials into penetrations in fire rated barriers such as penetrations to floor slabs in the telecommunication riser/chase to establish the fire-resistance rating and also to avoid fumes or gases from escaping or penetrating thru the barrier.

2. All penetrations through fire-rated building structures (walls and floors) shall be sealed with an appropriate firestop system.

1104.5.5 Quality Control

1. The Contractor shall require a duly Professional Electronics Engineer to be present at site to supervise and inspect the progress of work. The PECE shall also be the one who will certify the work at the completion of the project.

2. All equipment shall be brand new of a single manufacturer and conforming to the recognized internationally accepted materials.

3. Installation of the system shall be governed by the provision of the latest edition of the Philippine Electrical Code (PEC), Philippine Electronics Code and other existing rules and regulations of the locality and governing agencies.

4. The Contractor shall be responsible for all supervision, commissioning, tests and adjustment for the system. Such work shall be performed by or under direct supervision of a duly Professional Electronics Engineer.

5. Upon completion of the work, the Contractor shall present documentation to the Owner before commissioning of the system.

1104.5.6 Commissioning and Testing

All cables and hardware shall be 100% tested for defects prior to installation and to verify cable performance under installed conditions. All conductors of each installation cable shall be verified as useable by the Contractor prior to system acceptance.

All UTP and fiber optic cable field testing shall be performed with an approved test device, 100% of cables installed shall be tested and all shall result to PASS remarks channel or permanent link.

All field testers shall be factory calibrated every calendar year by the field test equipment manufacturer.

1104.5.7 Warranty

The Contractor shall provide a system warranty covering the installed materials against defects in workmanship, components, and performance and follow-on support after project completion.

1104.6 Method of Measurement

The quantity to be paid for payment shall constitutes all the completed and accepted work in a manner prescribed in the several items involved.

1104.7 Basis of Payment

The quantities measured as prescribed on Section 1104.5, Method of Measurement, shall be paid for at the contract lump sum price for the Auxiliary System which price and payments shall be full compensation for furnishing labor, equipment, supplies, materials, testing and incidentals necessary to complete the Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1104 (1)	Auxiliary System	Lump Sum

References:
1. *The Cabling Handbook*
2. *Design Guidelines, Criteria and Standards: Volume 6 – Public Buildings and Other Related Structures*
3. *ANSI/EIA/TIA 569-A, Commercial Building Standard for Telecommunication Pathways and Spaces.*
4. *EIA/TIA 607, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises*
5. *EIA/TIA-568-B.2, Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted – Pair Cabling Components*
6. *Internet: https://www.csd.uoc.gr~hy435/material/TIA-EIAA-568-B.2.pdf*
7. *Internet: https://www.anixter.com/content/dam/Anixter/Guide/7H0011X0_W&C_Tech_Handbook_Sec_06.pdf*
8. *Internet: http://www.csd.uoc.gr/~hy435/material/TIA-EIA-568-B.3.pdf*