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Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure

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PREFACE

Revision History

June 5, 2019
First publication of this standard, titled ANSI/BICSI N1-2019, *Installation Practices for Telecommunications and ICT Cabling and Related Cabling Infrastructure*

Translation Notice

This standard may have one or more translations available as a reference for the convenience of its readers. As that act of translation may contain inconsistencies with the original text, if differences between the translation and the published English version exist, the English text shall be used as the official and authoritative version.
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1 Introduction

1.1 Purpose
This standard specifies best practices for installation of telecommunications and information communication cabling used for communication, signaling, network and related applications. These installation practices are intended to facilitate compliance with applicable codes (e.g., National Electrical Code®, Canadian Electrical Code®) and to follow the recommendations and requirements of applicable standards.

1.2 Categories of Criteria
Two categories of criteria are specified - mandatory and advisory.

- Mandatory criteria generally apply to protection, performance, administration, and compatibility; they specify the absolute minimum acceptable requirements.
- Advisory or desirable criteria are presented when their attainment will enhance the general performance of system infrastructure in all its contemplated applications.

Mandatory requirements are designated by the word *shall*; advisory recommendations are designated by the words *should, may,* or *desirable,* which are used interchangeably in this standard. When possible, recommendations and requirements were separated to aid in clarity.

2 Scope

A structured cabling system is a complete collective configuration of cabling and associated hardware on a premise, which when installed provides a comprehensive telecommunications infrastructure. This infrastructure is intended to support a wide range of telecommunications and information communication technology (ICT) services such as telephone and computer networks. Figure 2-1 illustrates an example of components that comprise a structured cabling system.

This standard describes minimum requirements and procedures for installing the infrastructure supporting telecommunication and ICT cabling (e.g., balanced twisted pair copper cabling, optical fiber cabling) used for signal (e.g., voice, data, video) transmission. Installers should always follow applicable codes and manufacturers’ instructions. This standard is intended to be used in describing a “neat and workmanlike manner” as referenced by NFPA 70.

![Figure 2-1
Example of a Structured Cabling System

[Diagram of a structured cabling system with labels for Equipment Room (ER), Horizontal Cross-connect (HC), Intermediate Cross-connect (IC), Main Cross-connect (MC), Telecommunications Room (TR), Wireless Access Point, and Work Area Outlet.]

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3 Required Standards and Documents

The following standards and documents contain provisions that constitute requirements listed within this standard. Unless otherwise indicated, all standards and documents listed are the latest published version prior to the initial publication of this standard. Parties to agreement based on this standard are encouraged to investigate the possibility of applying a more recent version as applicable.

Where equivalent local codes and standards exist, requirements from these local specifications shall apply. Where reference is made to a requirement that exceeds minimum code requirements, the specification requirement shall take precedence over any apparent conflict with applicable codes.

*International Electrotechnical Commission (IEC)*
- ISO/IEC 61935-1, Specification for the testing of balanced and coaxial information technology cabling - Part 1: Installed balanced cabling as specified in ISO/IEC 11801 and related standards

*International Organization for Standardization (ISO)*
- ISO/IEC 30129, Information Technology – Telecommunications bonding networks for buildings and other structures

*National Fire Protection Association (NFPA)*
- NFPA 70®, National Electrical Code® (NEC®)

*Telecommunication Industry Association (TIA)*
- ANSI/TIA-455-78B; Optical Fibres – Part 1-40: Measurement Methods and Test Procedures – Attenuation
- ANSI/TIA-526-14-C, Optical Power Loss Measurement of Installed Multimode Fiber Cable Plant; Modification of IEC 61280-4-1 edition 2, Fiber-Optic Communications Subsystem Test Procedures- Part 4-1: Installed Cable Plant-Multimode Attenuation Measurement
- ANSI/TIA-568.0-D, Generic Telecommunications Cabling for Customer Premises
- ANSI/TIA-568.2-D, Balanced Twisted-Pair Telecommunications Cabling and Components Standards
- ANSI/TIA-569-D, Telecommunications Pathways and Spaces
- ANSI/TIA-606-C, Administration Standard for Telecommunications Infrastructure
- ANSI/TIA-607-C, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- ANSI/TIA-1152-A, Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
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4 Definitions, Acronyms, Abbreviations, and Units of Measurement

4.1 Definitions
For the purposes of this document, the following terms and definitions apply. Some terms and definitions may also be represented by an acronym as listed in Section 4.2.

administration
The method for labeling, identification, documentation and usage needed to implement moves, additions and changes of the telecommunications infrastructure.

alien crosstalk
Unwanted coupling of signals into a balanced twisted-pair in a given cable from one or more balanced twisted-pair(s) external to the given cable.

all-thread-rod
A straight section of round rod stock that has threads installed over its entire length. Also known as threaded rod.

American wire gauge
United States’ standard method for denoting the cross-sectional area of round conductors.

anchor
(1) A fastening device. (2) In an outside plant environment, a device made up of a single plate or series of flat plates and combined with a rod having a connecting eye.

attenuation
The decrease in magnitude of transmission signal strength between points, expressed in units of decibels (dB) from the ratio of output to input signal level. See also insertion loss.

authority having jurisdiction
The entities responsible for interpretation and enforcement of local building and electrical codes.

backboard
A panel (e.g., wood or metal) used for mounting connecting hardware and equipment.

backbone
(1) A facility (e.g., pathway, cable, conductors) between any of the following spaces: telecommunications rooms (TRs), common TRs, floor-serving terminals, entrance facilities, equipment rooms, and common equipment rooms (CER). (2) In a data center, a facility (e.g., pathway, cable, conductors) between any of the following spaces: entrance rooms or spaces, main distribution areas, intermediate distribution areas, horizontal distribution areas, and TRs.

backbone cabling
Cable and connecting hardware that provides interconnections between telecommunications rooms, equipment rooms, and entrance facilities. See backbone.

bandwidth
A measure of the range of frequencies associated with a given signal or communication channel, typically expressed in hertz. It is used to denote the potential transmission capacity of the medium, device, or system.

beam clamp
A device attached to a building structure to hold cable supports or equipment.

bend radius
The radius of curvature that a media can bend without signal degradation.

bonding
The permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to conduct safely any current likely to be imposed.

bonding conductor
A conductor used specifically for the purpose of bonding.

bonding conductor for telecommunications
A conductor that interconnects the telecommunications bonding infrastructure to the building’s service equipment (power) ground.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>braid</td>
<td>A group of non-insulated conductors interwoven to surround one or more insulated conductors.</td>
</tr>
<tr>
<td>bullwheel</td>
<td>A large wheel used to maintain an arc when feeding large cables into a backbone pathway.</td>
</tr>
<tr>
<td>bundle</td>
<td>A group of cables that are tied together or in contact with one another in a closely packed configuration for at least 600 mm (24 in).</td>
</tr>
<tr>
<td>cabinet</td>
<td>A container with a hinged cover that may enclose telecommunications connection devices, terminations, apparatus, wiring, and equipment.</td>
</tr>
<tr>
<td>cable</td>
<td>(1) An assembly of one or more insulated conductors or optical fibers within an enveloping sheath. (2) An assembly of one or more cable units of the same type and category in an overall sheath. It may include overall screen. (3) The act of installing cable.</td>
</tr>
<tr>
<td>cable run</td>
<td>A length of installed media, which may include other components along its path.</td>
</tr>
<tr>
<td>cable sheath</td>
<td>A covering over the optical fiber or conductor assembly that may include one or more metallic members, strength members, or jackets.</td>
</tr>
<tr>
<td>cable support system</td>
<td>A combination of conduits, cable trays, support hooks, tie-wraps, and any other hardware pieces used in a cabling installation to support cables. Cable support systems keep excess stress off the cables and may provide some mechanical protection to the cables being supported.</td>
</tr>
<tr>
<td>cable termination</td>
<td>The connecting or termination hardware applied to the end of a cable for the purpose of facilitating connection to active or passive transmission equipment.</td>
</tr>
<tr>
<td>cable tray</td>
<td>A support mechanism used to route and support telecommunications and other cable. Cable trays may be equipped with side walls or barriers to constrain a cable’s horizontal placement or movement.</td>
</tr>
<tr>
<td>cabling</td>
<td>A combination of all cables, jumpers, cords, and connecting hardware.</td>
</tr>
<tr>
<td>cabling system</td>
<td>A specific system of cables, equipment/patch cords, connecting hardware, and other components supplied as a single entity.</td>
</tr>
<tr>
<td>channel</td>
<td>The complete transmission path between two pieces of application-specific equipment. Equipment cords and work area cords are included in the channel.</td>
</tr>
<tr>
<td>channel stock</td>
<td>A metallic U-shaped bar with or without evenly spaced holes. Often hung in a trapeze configuration for support of pathway systems, such as conduits and cable trays.</td>
</tr>
<tr>
<td>circuit</td>
<td>The electrical or optical path used for communications between two devices.</td>
</tr>
<tr>
<td>code</td>
<td>A rule intended to ensure safety during the installation and use of materials, components, fixtures, systems, premises, and related subjects. Codes are typically invoked and enforced through government regulation.</td>
</tr>
<tr>
<td>conduit</td>
<td>(1) A raceway of circular cross-section. (2) A structure containing one or more ducts.</td>
</tr>
<tr>
<td>connecting hardware</td>
<td>A device, or combination of devices, used to connect two cables or cable elements.</td>
</tr>
<tr>
<td>connector</td>
<td>A mechanical device used to provide a means for aligning, attaching, and achieving continuity between conductors or optical fibers.</td>
</tr>
<tr>
<td>core</td>
<td>The central, light-carrying part of an optical fiber through which light pulses are transmitted.</td>
</tr>
<tr>
<td>crimp</td>
<td>The act of clamping connectors to a cable.</td>
</tr>
</tbody>
</table>
cross-connect  A facility enabling the termination of cabling elements and their interconnection or cross-connection.
cross-connection  A connection scheme between cabling runs, subsystems, and equipment using patch cords or jumpers that attach to connecting hardware on each end.
distribution ring  Wire management ring shaped like the letter D for routing and supporting distribution cables and jumpers/patch cables on a backboard.
dressing  Placing cables into a neat and symmetrical pattern for proper alignment and positioning for termination.
drywall  An interior wall construction consisting of gypsum or plasterboard
duct  (1) A single enclosed raceway for conductors, wires, or cables. See also raceway. (2) An enclosure in which air is moved. Generally, part of the heating, ventilating, and air-conditioning system of a building.
entrance facility (telecommunications)  (1) An entrance to a 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. (2) A facility that provides all necessary mechanical and electrical services for the entry of telecommunications cables into a building and that complies with all relevant regulations.
entrance room (telecommunications)  A space in which the joining of campus or building telecommunications backbone facilities takes place.
equipment room (telecommunications)-  An environmentally controlled centralized space for telecommunications and data processing equipment with supporting communications connectivity infrastructure.
firestop  The products, materials and methods used to seal penetrations of a fire resistive barrier that maintains the compartmentation in a building and limits the size and spread of fire and controls the movement of smoke.
firestop system  A specific listed assembly consisting of the material(s) (firestop penetration seals) that fill the opening in the wall or floor assembly, and around and between any items that penetrate the wall or floor (e.g., cables, cable trays, conduit, ducts, pipes), and any termination devices (e.g., electrical outlet boxes) along with their means of support.
firewall  A continuous barrier used to prevent fire spreading from one fire zone or area to another.
floor slab  (1) That part of a reinforced concrete floor, which is carried on beams below. (2) A concrete mat poured on subgrade serving as a floor rather than as a structural member.
foldback splicing  Process of folding back conductors in a splice for future maintenance or rearrangements.
ground  A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth or to some conducting body that serves in place of earth.
ground electrode  A conducting object through which a direct connection to earth is established.
grounded  Connected to earth or to some conducting body that serves in place of the earth.
ground wire  See bonding conductor and bonding conductor for telecommunications.
grounding system  A system of hardware and wiring that provides an electrical path from a specified location to an earth ground point.
horizontal cable Distribution media that connect the telecommunications outlet/connector at the work area and the first piece of connecting hardware in the horizontal cross-connect.

horizontal cross-connect A cross-connect allowing horizontal cabling to be interconnected to backbone cabling. A horizontal cross-connect may also be known as a floor distributor or FD.

infrastructure (telecommunications) A collection of those telecommunications components, excluding equipment, that together provide the basic support for the distribution of all information within a building or campus.

in-line splice A splice in which cable enters one endcap and, after splicing the cable, exits the other endcap of the closure.

innerduct A non-metallic pathway, usually circular, placed within a larger pathway.

insertion loss The signal loss resulting from the insertion of a component or link between a transmitter and receiver. Insertion loss is often referred to as attenuation.

insulation The dielectric material that physically separates wires and prevents conduction between them.

insulation displacement contact A type of wire termination in which the insulation that is surrounding a conductor is displaced at the connection point without physically stripping the insulation from the conductor and consequently makes a gas-tight connection to the conductor.

interconnection A connection scheme that employs connecting hardware for the direct connection of a cable to another cable without a patch cord or jumper, or employs a patch cord or jumper, to make a connection between connecting hardware and equipment.

j-hook A supporting device for horizontal cables that is shaped like a “J.” It is attached to some building structures. Horizontal cables are laid in the opening formed by the “J” to provide support for the cables.

jacket The outer layer of a cable. See also cable sheath.

jumper An assembly of twisted-pair conductors or balanced twisted-pair, optical fiber, or coaxial cable used to join telecommunications circuits and links at a cross-connect or between patch panels. Jumpers may have connectors at neither, one, or both ends of the assembly. See also cable assembly.

ladder rack A cable tray with side stringers and cross members, resembling a ladder, which may support cable either horizontally or vertically.

Listed Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction (AHJ), maintaining periodic inspection of production of listed equipment or materials or periodic evaluation of services and whose listing states either the equipment, material, or services meets appropriate standards or has been tested and found suitable for use in a specified manner.

link A transmission path between two points, not including equipment and cords.

local area network The standard industry term for a network installation that serves a relatively small area (e.g., structured cabling installation serving a building).

loss (1) Attenuation of a signal, usually measured in db. (2) In wireless applications, the attenuation undergone by an electromagnetic wave in transit between a transmitter and a receiver. It may be caused by many effects such as free-space loss, refraction, reflection, aperture-medium coupling loss, and absorption.

multimode optical fiber An optical fiber that carries many paths (modes) of light.
mushroom

See spool.

network

A series of controllers, all connected via a telecommunications cable.

optical fiber

A transmission media using a thin filament of glass or plastic to transmit pulse light signals. Its bandwidth is higher than copper and not subject to electromagnetic interference. The optical fiber consists of a central core (glass or plastic) and an outer cladding.

optical fiber cable

A cable made up of one or more strands of optical fibers, strength members, and an outer jacket.

outlet box

(telecommunications)

A metallic or non-metallic box mounted within a floor, wall, or ceiling and used to hold telecommunications outlets/connectors or transition devices.

pair

(1) Two insulated wires commonly joined. They can be twisted around each other or mated together as in flat cable. (2) One side circuit (two. diametrically facing conductors) in a star quad.

pair count

(1) Indicates how many pairs of grouped conductors are in a cable. (2) The pair identification of cable and pairs serving a location.

patch cord

A jumper with connectors on both ends used to join telecommunications circuits/links, for example between two patch panels.

pathway

(1) A sequence of connections that provides the connectivity between devices on a network or between networks on an internetwork. (2) The vertical and horizontal route of the telecommunications cable. (3) A facility for the placement of telecommunications cable.

pigtail

One or more conductors or fibers with only one end terminated.

premises

Building, or set of buildings on common property, that are occupied by a single tenant or landlord.

primary bonding busbar

A busbar placed in a convenient and accessible location and bonded, by means of the telecommunications bonding conductor, to the buildings service equipment (power) ground.

NOTE: Formerly known as the telecommunications main grounding busbar.

pull

(1) The act of placing cable by pulling. (2) The longitudinal force acting on a pole as a result of horizontal loading.

raceway

An enclosed channel of metal or nonmetallic materials designed expressly for holding wires or cables. Raceways include, but are not limited to: rigid metal conduit, rigid nonmetallic conduit, intermediate metal conduit, liquid tight flexible conduit, flexible metallic tubing, flexible metal conduit, electrical nonmetallic tubing, electrical metallic tubing, underfloor raceways, cellular concrete floor raceways, cellular metal floor raceways, surface raceways, wireways, and busways.

NOTE: Cable tray is not considered a type of raceway.

rack

See cable rack.

reel brake

A device used to control the rate of removal of a cable from a cable reel.

ring

A means for identification of one conductor of a pair. Historically associated with the wire connected to the “ring” portion of an operator’s telephone plug. See also tip.

secondary bonding busbar

A common point of connection for telecommunications system and equipment bonding to ground, and located in the distributor room

NOTE: Formerly known as the telecommunications grounding busbar.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>screened twisted-pair cable</td>
<td>A cable with one or more pairs of twisted copper conductors covered with an overall metallic shield.</td>
</tr>
<tr>
<td>sheath</td>
<td>See cable sheath.</td>
</tr>
<tr>
<td>shield</td>
<td>A metallic layer (e.g., copper braids, metal foils, solid tubing) placed around a conductor or group of conductors.</td>
</tr>
<tr>
<td>short</td>
<td>An unintentional low-resistance connection between two conducting materials.</td>
</tr>
<tr>
<td>single-mode optical fiber</td>
<td>Optical fiber with a core diameter of typically 8–9 microns (micrometers), surrounded by a cladding with an overall diameter of 125 microns. Lightwave propagation is restricted to one path or mode through the core.</td>
</tr>
<tr>
<td>sleeve</td>
<td>An opening, usually circular, through the wall, ceiling, or floor to allow the passage of cables.</td>
</tr>
<tr>
<td>space (telecommunications)</td>
<td>An area whose primary function is to house the installation and termination of telecommunications equipment and cable (e.g., equipment room, telecommunications room, entrance facility).</td>
</tr>
<tr>
<td>splice</td>
<td>(1) A joining of conductors in a splice closure, meant to be permanent. (2) A device that joins conducting or transmitting media.</td>
</tr>
<tr>
<td>splice case</td>
<td>A metal or plastic housing with a semicylindrical cavity used in identical pairs to clamp around a cable splice to provide a closure.</td>
</tr>
<tr>
<td>splice closure</td>
<td>A device used to protect a splice. See splice case.</td>
</tr>
<tr>
<td>split pair</td>
<td>Transposition of two conductors of separate pairs.</td>
</tr>
<tr>
<td>spool</td>
<td>(1) Cylindrical containers of cable and may also be known as a cable reel. (2) A cylindrical guide, typically used for routing jumpers, cross-connects, and patch cords.</td>
</tr>
<tr>
<td>suspended ceiling</td>
<td>A ceiling that creates an area or space between the ceiling material and the building structure above.</td>
</tr>
<tr>
<td>telecommunications</td>
<td>Any transmission, emission, and reception of information (e.g., symbols, signals, writings, images, sounds) by cable, radio, optical, or other electromagnetic systems.</td>
</tr>
<tr>
<td>telecommunications connector</td>
<td>The receptacle and insertion elements which provide a means of aligning, attaching and achieving continuity between the conductors and optical fibers used within telecommunication and information communication and technology (ICT) applications.</td>
</tr>
<tr>
<td>telecommunications enclosure</td>
<td>A case or housing for telecommunications equipment, cable terminations, and cross-connect cabling.</td>
</tr>
<tr>
<td>telecommunications entrance facility</td>
<td>See Entrance Facility (Telecommunications).</td>
</tr>
<tr>
<td>telecommunications entrance room</td>
<td>See Entrance Room (Telecommunications).</td>
</tr>
<tr>
<td>telecommunications equipment room</td>
<td>See Equipment Room (Telecommunications).</td>
</tr>
<tr>
<td>telecommunications outlet</td>
<td>An assembly of which consists of a faceplate, body, housing, or supporting bracket, and one or more receptacles or jacks of a telecommunication connector. Telecommunications outlets are typically located to provide ease of connection for communication and data equipment (e.g., computer, phone).</td>
</tr>
<tr>
<td>Term</td>
<td>Description</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>telecommunications room</td>
<td>A telecommunications space that differs from equipment rooms and entrance facilities in that this space is generally considered a floor-serving or tenant-serving (as opposed to building- or campus-serving) space that provides a connection point between backbone and horizontal cabling.</td>
</tr>
<tr>
<td>tip</td>
<td>A means for identification of one conductor of a pair. Historically, associated with the wire connected to the tip portion of an operator’s telephone plug. See also ring.</td>
</tr>
<tr>
<td>trapeze</td>
<td>A support device using threaded rod and channel stock.</td>
</tr>
<tr>
<td>twisted-pair</td>
<td>Two individually insulated copper wires physically twisted together to form a balanced pair.</td>
</tr>
<tr>
<td>twisted-pair cable</td>
<td>A multiconductor cable comprising two or more copper conductors twisted in a manner designed to cancel electrical interference. Also called balanced twisted-pair cable.</td>
</tr>
<tr>
<td>underfloor raceway</td>
<td>A pathway placed within the floor and from which wires and cables emerge to a specific floor area.</td>
</tr>
<tr>
<td>unshielded twisted-pair cable</td>
<td>Cable containing one or more pairs of twisted copper without metallic shielding. The entire assembly is covered with an insulting sheath (cable jacket).</td>
</tr>
<tr>
<td>wavelength</td>
<td>The distance between two points in the same phase in consecutive cycles measured in the direction of propagation.</td>
</tr>
<tr>
<td>wire</td>
<td>An individually insulated solid or stranded metallic conductor.</td>
</tr>
<tr>
<td>wireway</td>
<td>See raceway.</td>
</tr>
<tr>
<td>work area (workstation)</td>
<td>A building space where the occupants interact with telecommunications terminal equipment.</td>
</tr>
<tr>
<td>work area outlet</td>
<td>A connecting device for termination of horizontal media. See also telecommunications outlet.</td>
</tr>
</tbody>
</table>

### 4.2 Acronyms and Abbreviations

Abbreviations and acronyms, other than in common usage, are defined as follows:

- **AHJ**: authority having jurisdiction
- **IDC**: insulation displacement contact
- **AWG**: American Wire Gauge
- **IMC**: intermediate metal conduit
- **ATR**: all-threaded-rod
- **MC**: main cross-connect
- **CPR**: coupled power ratio
- **OLTS**: optical loss test set
- **EF**: entrance facility
- **OTDR**: optical time domain reflectometer
- **EMI**: electromagnetic interference
- **PBB**: primary bonding busbar
- **EMT**: electrical metallic tubing
- **RMC**: rigid metal conduit
- **ER**: equipment room
- **SBB**: secondary bonding busbar
- **HC**: horizontal cross-connect
- **ScTP**: screened twisted-pair
- **HVAC**: heating, ventilation, and air conditioning
- **TR**: telecommunications room
- **IC**: intermediate cross-connect
- **UTP**: unshielded twisted-pair
- **ICT**: information communication technology
4.3 Units of Measurement

The units of measurement used in this standard are metric. Approximate conversions from metric to U.S. customary units are provided in parentheses; e.g., 100 millimeters (4 inches).

Units of measurement used in this standard are defined below:

- $\mu$m micrometer, micron
- km decibel
- dBm decibel milliwatt
- ft feet, foot
- in inch
- km kilometer
- m meter
- MHz megahertz
- mm millimeter
5 Regulatory and Other Requirements

5.1 Usage
Local code requirements shall be followed. Always review the local code requirements with the authority having jurisdiction (AHJ) before proceeding with the installation. This includes reviewing what code and edition is adopted, and what, if any, exceptions to the code are adopted by the governing authority. Most of the code requirements for the job should be included in the scope of work documents. The installer should never take this information for granted.
If no code has been adopted locally, consult with fire or building AHJs to determine what agency is responsible for that geographic area and what codes are in effect. Do not depend on other installers, contractors, or even company personnel in making these determinations.
Only qualified persons familiar with telecommunications cabling should perform the work described in this publication.