Communication Conduit for Fiber Optics

Scope of Standard

These guidelines identify and define the City of Clermont requirements and policies for designing and installing telecommunications infrastructure and substructure at all City of Clermont facilities. Use of, and compliance with these guidelines is mandatory for architects, engineers, and installation contractors working on City of Clermont projects.

Design Guidelines

A. The City of Clermont Infrastructure Standard is based upon the code requirements and telecommunications industry standards contained in the following guidelines. These guidelines will not duplicate the information contained in those references, except where necessary to provide guidance, clarification or direction.
B. In instances where several technical alternatives may be available to provide a design solution, these guidelines will identify the preferred solution to meet City of Clermont needs. However, each facility and project is unique. Design for new construction will differ from design for retrofit of existing facilities. These guidelines will differentiate certain design approaches and solutions to be applied to new construction versus existing facilities, and different types of City of Clermont facilities. However, designers and installers shall always use sound engineering judgment in order to comply with the requirements of the codes and standards identified in this section.

Reference Standards

A. Adherence to, and compliance with, the codes and standards referenced, and the City of Clermont's unique requirements and design solutions identified in the manual, is mandatory. Requests to deviate from the industry standards and design solutions prescribed in these guidelines may be submitted, on a case-by-case basis, to the City Engineer for review and approval. No deviation from the requirements of the National Electrical Code will be allowed.
B. Architects, Consultants, and Contractors shall always reference the most recent standards available. Most references listed below can be purchased directly from the individual standards organization, or from:

Global Engineering Documents
15 Inverness Way East
Englewood, CO 80112-5776
Telephone: (800) 854-7179 (303) 397-7956
Fax: (303) 397-2740
http://www.global.ihs.com

Codes, Standards, References, and Applicability

Design, Build Firm to follow all standards, references an technical special provisions referenced below.

A. **NATIONAL ELECTRICAL CODE, NFPA 70:** The National Fire Protection Association has acted as the sponsor of the National Electrical Code (NEC) since 1911. The original Code was developed in 1897 as a result of the united efforts of various insurance, electrical, architectural, and allied interests. The purpose of the NEC is the practical safeguarding of persons and property from hazards arising from the use of electricity. The NEC provides the minimum code requirements for electrical safety. In telecommunications distribution design, the NEC must be used in concert with the ANSI/EIA/TIA standards identified below, which are intended to insure the performance of the telecommunications infrastructure.

B. **ANSI/TIA/EIA STANDARDS:** The Telecommunications Industry Association/Electronics Industry Association (TIA/EIA) engineering standards and publications are designed to serve the public interest through eliminating misunderstandings between manufacturers and purchasers. The standards facilitate interchangeability and improvement of products and assist the purchaser in selecting and obtaining the proper product for his or her particular need.

The TIA/EIA Standards are updated every five years. Due to the rapid changes in the telecommunications and electronics industries, TIA/EIA publishes periodic Telecommunications Systems Bulletins (TSB), which provides additional guidance on certain technical issues that must be addressed prior to the next scheduled revision of the standards. The information contained in TSBs is usually incorporated into the applicable standard during the next standards revision. Standards and publications are adopted by TIA/EIA in accordance with American National Standards Institute (ANSI) patent policy. The TIA web site is: http://www.tiaonline.org/

C. **FIBER OPTIC TEST STANDARDS,TIA/EIA-526 (SERIES):** The TIA/EIA-455 series, together with its addenda, provides uniform test procedures for testing the fiber optic components intended for, or forming a part of, optical communications and data transmission systems. This series contains standard test procedures for optical fibers, cables, transducers, and connecting and terminating devices.

D. **CABLING STANDARD, ANSI/TIA/EIA-568 (SERIES):** The ANSI/TIA/EIA-568-A series, together with its addenda is the Commercial Building Telecommunications Cabling Standard. This standard defines a generic telecommunications wiring system for commercial buildings that will support a multiproduct, multivendor environment. It also provides direction for the design of telecommunications products for commercial enterprise.

The purpose of the standard is to enable planning and installation of building wiring with little knowledge of the telecommunications products that subsequently will be installed. Installation of wiring systems during building construction or renovation is significantly less expensive and less disruptive than after the building is occupied. TIA/EIA-568-A series establishes performance and technical criteria for various wiring system configurations for interfacing and connecting their respective elements.

E. **GROUNDING AND BONDING, ANSI/TIA/EIA-607 (SERIES):** The ANSI/TIA/EIA-606 (series) is the Commercial Building Grounding and Bonding Requirements for Telecommunications. The National Electrical Code (NEC) provides grounding, bonding, and electrical protection requirements to ensure life safety. Modern telecommunications systems require an effective grounding infrastructure to insure optimum performance of the wide variety of electronic information transport systems that may be used throughout the life of a building. The grounding and bonding requirements of this standard are additional technical requirements for telecommunications that are beyond the scope of the NEC. These standards are intended to work in concert with the cabling topology specified in ANSI/TIA/EIA-568-A series, and installed in the pathways and spaces designed in accordance with ANSI/TIA/EIA-569-A.

F. **CUSTOMER OWNED OUTSIDE PLANT (OSP), ANSI/TIA/EIA-758:** The ANSI/TIA/EIA-758 provides industry standards for the design and construction of customer owned OSP infrastructure. Unless specified otherwise in the City of Clermont standard OSP designed and constructed at all City of Clermont facilities will be in compliance with ANSI/TIA/EIA-758.

G. **TRANSMISSION PERFORMANCE SPECIFICATIONS, TIA/EIA BULLETIN TSB67:** TSB67 is the Transmission Performance Specification for Field Testing of Unshielded Twisted- Pair (UTP) Cabling Systems. This bulletin specifies the electrical characteristics and performance requirements of field test instruments, test methods, and the minimum transmission requirements for UTP cabling. All testing of horizontal distribution cabling at City of Clermont facilities will be performed with a TSB67 Level II test instrument.

H. **ADDITIONAL HORIZONTAL CABLING PRACTICES FOR OPEN OFFICES, TIA/EIA BULLETIN TSB75:** This document specifies optional practices for open office environments, for any horizontal telecommunications cabling recognized in TIA/EIA-568. It specifies optional cabling schemes and topologies for horizontal cabling routed through modular office furniture or movable partitions, which are frequently reconfigured

I. **LOCAL AREA NETWORK ETHERNET STANDARD, IEEE 802.3 (SERIES)**
City of Clermont utilizes the Ethernet LAN protocol at all facilities. All City of Clermont infrastructures must be designed to support the Institute of Electrical and Electronic Engineers (IEEE) Ethernet 802.3 standards, which define protocols and signaling technologies. All newly installed cabling must support 1000BaseX Gigabit Ethernet protocol based on the IEEE 802.3z standard.

J. **THE BICSI TELECOMMUNICATIONS DISTRIBUTION METHODS MANUAL:** The Building Industry Consulting Service International, Inc. (BICSI) is a Telecommunications Association whose mission is to provide state-of-the-art telecommunications knowledge to the industry, resulting in good service to the end user. BICSI develops and publishes the Telecommunications Distribution Methods Manual (TDMM). The TDMM is not a code or standard. The TDMM is an extensive volume of information on the various aspects of telecommunications systems and telecommunications distribution. The TDMM provides discussions and examples of various engineering methods and design solutions that can be selected and employed in order to meet the requirements of the NEC and ANSI/TIA/EIA standards. Designers and installers are encouraged to use the TDMM as an engineering tool, within the constraints of the unique requirements of the City of Clermont Infrastructure Standards.

K. **THE FLORIDA DEPARTMENT OF TRANSPORTATION (FDOT):** Refer to the current standard for FDOT Intelligent Transportation Systems, Technical Special Provisions Sections 783 Fiber Optic Cable and Interconnect;

L. **INTERNATIONAL TELECOMMUNICATIONS UNION – (ITU-T 652 Categories A, B, C, D):** Refer to the international standard on Fiber Optic Cable covering “reduced-water-peak”, “low-water-peak” and “full=spectrum fiber”. Material deployed in the project shall be ITU-T 652.D full spectrum compliant such as Corning SMF-28e for full compatibility and interoperability with legacy fiber, while providing low Polarization Mode Dispersion (PMD).

Definitions

***Fiber Optic Cable*:** A cable that contains individual glass fibers, designed for the transmission of digital information, using light pulses.

***All Dielectric Self Support (ADSS) Cable*:** A cable designed and constructed with non-metallic components, that is designed for aerial applications and does not require a separate cable messenger.

Loose Tube Cable: A cable designed and constructed with non-metallic components, that is designed for underground applications. These are "dry" cables using water swellable powders to protect against water penetration.

OTDR: *Optical Time Domain Reflectometer*. A device used for characterizing a fiber, wherein an optical pulse is transmitted through the fiber and the resulting backscatter and reflections are measured as a function of time.

***Single-mode Fiber*:** An optical fiber with a small core diameter, in which only a single mode of light is capable of propagation. All Single mode glass employed on project shall meet or exceed .35/.25dB/km optical attenuation and Polarization Mode Dispersion: $\leq$0.5 ps / km

***Multi-mode Fiber*:** An optical fiber whose core diameter is large compared with the optical wavelength and which, consequently, a large number of light modes are capable of propagation.

Splicing: A permanent junction between optical fiber splices. May be thermally fused or mechanically applied.

***Minimum Bend Radius*:** The minimum radius a fiber may be bent before optical losses are induced.

Guidelines for Designing Underground Fiber Optic Cable Routes

The referenced RFB document shall pertain to anything not explicitly stated in this document. Governing FDOT Indexes and regulations should be used as well as all applicable codes in force.

Conduit Placement

The conduit shall be placed at an offset from the roadway that meets the governing FDOT regulations and Indexes while still staying within the ROW. If this cannot be accomplished please raise issue to the City of Clermont project engineer or liaison.

Depth (Minimum / Maximum)

The conduit used as the primary carrier of the fiber optic cable should be buried no greater than 42.” and no less than 36.” beneath grade except where code requires otherwise or directed in writing by the Project Engineer on behalf of the City of Clermont.

Grade away from Buildings/Structures

The conduit shall be placed in such a way to as to maintain a gradual grade down away from buildings and other major structures.

Conduit type/ Inner Duct type

Standard placement shall be of quantity (1), 2” ID HDPE conduit direct buried/trenched/bored as appropriate to the construction needs (Color Orange). If specified an outer conduit shall be of the HDPE type, of suitable strength per the governing FDOT indexes for the location of work. Conduit shall be 6” I.D. in size with quantity (1), 2” ID HDPE conduits (Color Orange)

All conduits and inner ducts should be cleared and cleaned prior to capping.

Conduit Turns & Transitions

All conduit turns shall be made with 45 degree bends or sweeps. At no time shall 90 degree bends be utilized in the outside plant arena, unless it is an already existing conduit, and approved by the City of Clermont.

Exceptions may be made to this rule for work inside of buildings.

Trace Wire

A minimum #12 AWG trace wire should be placed along with all conduits put in place. This trace wire should maintain continuity from end station to end station. Where possible it is okay to use vaults/hand holes for joining the trace wire, while keeping these joints visible and out of the way of the fiber cable. Where not possible please use the small hand hole for joining the trace wire.

Marker Poles

Easily visible, marked, 6.' fiber optic marker poles should be placed above the conduit at all major transitions to said conduit (turns greater than 25 degrees etc). Please get marking poles approved by the City of Clermont prior to installation/purchase.

Conduit Entering Hand Holes/Man Holes

All conduits should be stubbed up underneath the bottom of each manhole/hand hole leaving at least 8." but no more than 12." of visible conduit exposed. Conduit and inner ducts should be capped until use, after use they should be plugged appropriately to maintain the integrity of the conduit/inner duct from dirt and water.

Locate Information

As an as-built information gathering job, all splice points, vaults/hand hole/manhole/conduit turns of 45 degrees or greater should receive a GPS coordinate that is marked and labeled back onto the as-built drawings.

Building Entrances

All building entrances should be checked and approved with the City of Clermont Project Engineer or liaison. Preference is given in the following order (but dictated by the facility itself) core drilling and bringing conduit up through the floor, utilizing existing conduit to enter the building, bringing conduit up the outside of a facility, attaching a pull box to the exterior of said building and entering through the wall of the building.

Box Sizing

Please confirm with the City of Clermont your selection of boxes and box sizes PRIOR to utilization of said boxes in quote or design. All boxes utilized MUST meet the FDOT applicable Indexes and be on the FDOT approved equipment list. The following sizes are to be used wherever possible:

16x22x18." (straight wall)
16x22x30." (flared wall)
17x30x18." (flared wall)
24x36x30." (flared wall)
30x60x36." (flared wall)

Please get all boxes approved during the design phase and prior to purchasing/installation of said boxes. All box lids shall have a Logo embedded on them. This logo is to be provided by the City of Clermont.

Guidelines for Installing/Pulling Underground Fiber Optic Cable

Bend Radius

The main risk of damage to the fiber optic cable is by overlooking the minimum bending radius. It is important to know that the damage occurs more easily when the cable is bent under tension, so when the installation is in process be sure to allow for at least the minimum bending radius. The number of 90 degree turns on a pull shall not exceed four (4).

Reel Placement

Have the reel set adjacent to the manhole and use a fiber optic manhole pulling block assembly from Sherman & Reilly (or similar).

Cable Slack

Please coil 150 feet of cable at the Transition, Termination points, and every 1500 feet. Splices: All splice locations will be designated by the City of Clermont.

Strength

The fibers in the cable will shatter under considerable impact, pressure or if pulling tensions exceed 600 LB, although from the outside of the cable this will not be apparent. With fiber optic cable the jacket of the cable and the Kevlar layer directly beneath give the cable its strength so please be sure to note and repair all nicks and cuts.

Installation

When installing use a swivel eye for pulling the fiber optic cable and conduit system.

Precautions

Please review the manufacturer's installation instructions prior to commencing with the installation. If any questions arise during installation please refer to the manufacturer's installation instructions, or notify the project engineer.

Testing

Perform OTDR test on each fiber in the installed cable, to verify the parameters of each fiber meet the system design criteria. Power meter tests should also be performed. Both of these tests should be performed as stated in the referenced RFP and as stated elsewhere in this document.

Guidelines for Installing Conduit

Depth (Minimum / Maximum)

The conduit used as the primary carrier of the fiber optic cable should be buried no greater than 42.” and no less than 36.” beneath grade except where code requires otherwise or directed in writing by the Project Engineer on behalf of the City of Clermont.

Reel Placement
Have the reel set adjacent to the manhole and use a fiber optic manhole pulling block assembly.

Conduit type/ Inner Duct type
Standard placement shall be of quantity (1), 2” ID HDPE conduits (Color Orange), direct buried/trenched/bored as appropriate to the construction needs.

If specified an outer conduit shall be of the HDPE type, of suitable strength per the governing FDOT indexes for the location of work. Conduit shall be 6” I.D. in size with quantity (1), 2” ID HDPE conduits (Color Orange).

All conduits and inner ducts should be cleared and cleaned prior to capping.

Safety

Contractor to provide proper work zone safety through an approved site specific maintenance of traffic plan.

Contractor to ensure that all personnel working in the field adhere to all PPE (Personnel Protection Equipment) requirements needed for the particular job location at all times.

Contractor to conduct pre-work safety briefings with workers prior to starting work each day/shift in the field. This briefing should be conducted by supervisor/manager in the field. All safety briefings should be logged in paper and this log easily accessible by / to a City of Clermont Personnel in the field.

Locating Fiber Optic Cables

Florida Statute 556.101-111 requires all excavators to call for locates 48 hours before they dig. The Sunshine State One-Call of Florida phone # is 1-800-432-4770.

The One-Call office will contact the City of Clermont locating contractor requiring locates of our facilities.

Aiding the locators, please install a #12 gauge wire. Pull #12 gauge wire in with the Fiber cable for the Directional Bored conduit systems.

Terminate the ends of the #12 gauge wire in a handhold box. This box can be used by the locating contractor.