CONSTRUCTION OF FIBER-TO-THE-PREMISE DISTRIBUTION and DROP NETWORK in BREMER COUNTY, IA

3.1 Scope of Standard

These guidelines identify and define the requirements and policies for installing broadband infrastructure and substructure at all Waverly Communications Utility facilities. Use of, and compliance with these guidelines is mandatory for architects, engineers, and installation contractors working on WAVERLY COMMUNICATIONS UTILITYprojects.

3.2 Waverly Communications Utility– Broadband Infrastructure Standards

Splitter Cabinets - Splitter cabinets shall be a Clearfield or equivalent solution and will be supplied by Waverly Communications Utility.
Conduit – All conduit shall be Orange High Density Polyethylene SDR 13.5, Blue Diamond, Duraline or equivalent and will be supplied by Waverly Communications Utility.
Ground Vaults – Vaults will be supplied by Waverly Communications Utility.
Splice Cases – Splice closures with trays will be supplied by Waverly Communications Utility
Fiber Optic Cable – All fiber optic cable is supplied by Waverly Communications Utility and will be OFS fiber or equivalent, footage marked in feet, single-mode, non-armored URD cable
Fiber Drop Cable - All fiber optic cable is supplied by Waverly Communications Utility and will be Corning/ROC or equivalent drop cable assembly, single, SMF.

3.3 Reference Standards

A. Adherence to, and compliance with, the codes and standards referenced, and Waverly Communications Utility 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, in accordance with the instructions in the Policy and Procedures section of these guidelines. 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
Inverness Way East Englewood, CO 80112-5776
Telephone: (800) 854-7179 (303) 397-7956
Fax: (303) 397-2740
http://www.global.ihs.com

3.4 Codes, Standards, References, and Applicability

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) 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 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, 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 Waverly Communications Utility standard OSP designed and constructed at all Waverly 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 Waverly 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. 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 Waverly Communications Utility Infrastructure Standards.

J. NATIONAL ELECTRIC SAFETY CODE

The NESC sets the ground rules for practical safeguarding of persons during the installation, operation, or maintenance of electric supply & communication lines & associated equipment. It contains the basic provisions that are considered necessary for the safety of employees & the public under the specified conditions. The NESC continues to be a stronghold in the U.S. electrical industry & communications utility field, & serves as the authority on safety requirements for power, telephone, cable TV, & railroad signal systems.

3.5 Definitions

DOT: Department of Transportation.

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.

Drop cables, are located on the subscriber end to connect the terminal of a distribution cable to a subscriber's premise. Drop Cables are typicality small diameter, low fiber count cables with limited unsupported span lengths, which can be installed aerially or underground.

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.

Splicing: A permanent junction between optical fiber splices. Must be thermally fused.

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

3.7 Guidelines for Installing Underground Fiber Optic Cable Routes

Governing DOT 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 DOT regulations and Indexes while still staying within the ROW. If this cannot be accomplished, please raise issue to a Waverly liaison.

Depth (Minimum / Maximum)

The conduit used as the primary carrier of the fiber optic distribution cable should be buried no greater than 36” and no less than 30” beneath grade except where code requires otherwise or directed in writing by the Waverly Communications Utility Outside Plant Supervisor. Drop Conduit should be buried no greater than 18” and no less than 12 inches below grade

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

Buried Conduit shall be Orange High Density Polyethylene SDR 13.5; bored conduit shall be HDPE SDR 13.5 Inner duct, where required, shall be of the HDPE smooth wall type as well. Inner duct requirements (size and amount) shall be discussed with Waverly Communications Utility.

All couplers must be press-on or screw-on aluminum of Carlon quality or approved alternative.

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 already existing conduit, and approved by Waverly.

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 acceptable to use vaults/hand holes for joining the trace wire, while keeping these joints visible and out of the way of the fiber cable.

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. All conduits and inner ducts should be cleared and cleaned prior to capping. All ducts should be proofed and sealed using physical duct plugs.

Locate Information

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 Waverly Project 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
All boxes utilized MUST meet the DOT applicable Indexes and be on the DOT approved equipment list. The following size are to be used:

All boxes will be set on a compacted 2" base of gravel or #57 stone for drainage.

3.8 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-bend 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-bend 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).

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 Waverly Communications Utility Outside Plant Supervisor

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. Test results are to be provided to Waverly representatives.

3.9 Technical Specifications for the Installation of Fiber Optic Cable

Introduction
Waverly Communications Utility will purchase and provide all the Fiber Optic Cable, Conduit Pedestals, and Splice Tray for the project.

Installation Standards
Underground Inter-Building Cable
All fiber cable is to be protected with inner duct. After installation, inner ducts are to be permanently labeled as containing fiber optic cable, per Waverly instructions.

At no time shall more than 400 pounds of tension be placed on any fiber cable while it is being pulled through tray or conduit. It is preferred that all fiber cable be pulled with hand power only. If power winches or mechanical advantage devices are used to pull cable, a tension meter must be used to insure that maximum tension is not exceeded. Alternatively, a "mechanical fuse" rated at 350 pounds may be included in the linkage. Torsion shall be avoided by the use of a swivel at the cable end. While under tension, a minimum bend radius of 20 times the outside cable diameter will be maintained through the use of pulleys and sheaves where required. After pulling, no bend may have a radius, at rest, of less than 10 times the outside cable diameter.

Labeling
Each cable and inner duct is to be permanently labeled at each end with a unique cable number. In addition, labels shall be affixed to the cable/inner duct at every transition of a vault, hand hole, riser closet, or major pull box.

Each fiber optic strand shall be labeled with a unique identifier at the SC coupler in the fiber panel. Connectors shall be labeled on the identifying sheets on the front of the fiber panel.

Fiber Organizers
Fiber cables are to be terminated in one of two types of enclosures. Either wall-mounted or rack-mountable stand-alone units for installation. The final choice of fiber organizer shall be cleared with Waverly Communications Utility prior to installation.

Each closure shall be labeled with a machine-made label with permanent black ink on a white background. Each fiber optic strand shall be labeled with a unique identifier at the SC coupler in the FP. Connectors shall be labeled on the identifying sheets on the front of the FP. Each fiber shall be labeled where it enters the back of the coupler panels. Consult Waverly on specific labeling scheme.

Connectors and Splices
Fiber ends are to be terminated in SC-type connectors with composite ferrules. They must be of the "epoxy and polish". All splices must be fusion spliced. Mechanical splicing is not allowed inside Waverly facilities or Plant.

Miscellaneous

At each end of the cable, sufficient slack (50 feet) shall be left to facilitate reasonable future relocation of the FP. Slack shall be mounted on walls or upper ladder racks.

Placement of Aerial Fiber

Fiber will be placed in both the communications space and the electrical space on WAVERLY MUNICIPAL ELECTRIC UTILITY's poles. Contractors must be qualified to work in the electrical space for installation of the aerial fiber.

Testing

Before Installation

Fiber-Optic cable shall be pre-tested by Waverly Communications Utility as specified by the "OSP Standards" prior to any burial. Full "reel testing" shall be performed on any cable, prior to installation.

After Installation and termination

Single mode strands shall be tested end-to-end by Contractor, 1310 nm/1550 nm for single mode fibers. Tests should be conducted in compliance with EIA/TIA-526-14 or OFSTP 14, Method B, according to the manufacturer's instructions for the test set being utilized.

Tests must ensure that the measured link loss for each strand does not exceed the "worst case" allowable loss defined as the sum of the connector loss (based on the number of mated connector pairs at the EIA/TIA-568 B maximum allowable loss of 0.75 dB per mated pair) and the optical loss (based on the performance standard above).

After the cable is in place it shall be tested in the following manner:

a. After termination, each fiber shall be tested with an ODTR for length, transmission anomalies, and end-to-end attenuation. Results are to be recorded and supplied to Waverly in the form of hard-copy printouts. In addition, electronic copies of all test results shall be provided to Waverly along with any required viewing programs.
b. After termination and bulkhead mounting, each terminated fiber is to be tested for end-to-end loss with a power meter/light source; bi-directionally. As above, results are to be recorded and supplied to Waverly.
c. The maximum allowable attenuation for any splice or termination is 0.3dB.
d. Test results must be delivered in PDF format and must be entered on the test sheets provided.

The contractor shall review all end faces of field-terminated connectors with a fiber inspection scope. Connector end faces with hackles; scratches, cracks, chips and or surface pitting shall be rejected and re-polished or replaced if re-polishing will not remove the end face surface defects. The recommended minimum viewing magnifications for connector ends are 200X for single mode fiber.

The contractor shall verify continuity of conduit from fiber backbone to all traffic control cabinets in route.